Merry **xRMaaS**: last generation of analytical relationship management tools to the rescue of mental health area

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***Resumen*—Historically, healthcare systems have been used largely as repositories for clinical record storage with limited functions in terms of action at all, whether reactive and dashboards, or proactive reminders about emergent health changes for patients**

In sharp contrast, business information systems, especially in the field of Anything Relationship Management (xRM), have seen considerable advances making data and analytics more closely linked. These advances have given businesses the power instead of only storing customer data, to mine it for important details, predict future developments, and engage with customers in ways that are fluid and tailored to individual needs

Putting these breakthroughs into practice in mental health care could mark a giant stride forward. By making use of the data and analysis capabilities inherent in an analytical xRMaaS (Anything Relationship Management as a Service), mental health systems have the potential to change qualitatively. They could move from being no more than giant storerooms for clinical material toward devices that actively produce tailored, effective and efficient programs of mental health care for everyone involved.

I. Introduction

Healthcare IT systems are also behind the curve as business systems quickly integrate new technologies: interface intelligence, data mining, big data analysis. Existing business systems embrace multiple capabilities, functioning through data analysis, trend forecasting and strategic decision-making. They change easily with changes in the business environment for instantaneous response. In contrast, healthcare information systems have been much slower to evolve. While these systems capture large amounts of essential patient information, including medical history data and descriptive diagnosis details, their main functions are still tied to documentation and retrieval. Systems like these often lack fine-grained analytical tools that might help reveal the patient's underlying health risks even before they become evident or could provide ongoing, time-series information for actual patient care. This kind of drawback is particularly telling in the realm of patient care management. For example, if a patient's health records uncover a developing risk factor, more advanced systems might alert healthcare providers to intervene immediately. Moreover, such systems could become essential for managing chronic diseases: by analyzing patient data on an ongoing basis they could suggest modifications to treatment approaches or adjustments in lifestyle.

Moreover, to fully realize the potential of patient care; electronic medical systems should be combined with progress in other technologies such as computers and communications.This covers telemedicine, remote patient monitoring and personalized medicine. With more advanced systems [1], healthcare personnel could not only have a patient's medical history in front of them, but also gain insights and recommended actions from a comprehensive analysis of current information.In short, the information systems of the healthcare sector are vastly different from those in commerce. Using more sophisticated technologies could make these systems active tools that create good for patients and the health of populations rather than simply static repositories of data.For example, the implementation of social xRM technologies has great potential to modernize health systems and allow real-

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time interactions across a variety of channels. New thinking in this area can greatly increase the efficiency and availability of health care services. In particular, this approach has more certainty over mental health. Some major advantages of this approach include:

- **Enhanced Personalization**: In accordance with the individual patient history, preferences, and outcomes of treatments received previously it makes a highly personalized care plan. Such tailoring of care can work better for patients both in terms of efficacy and happiness.
- **Predictive Modeling**: The use of predictive analytics can detect and help prevent mental health problems such as psychosis, depression and many others. This preventive approach matters greatly for managing and preventing the growth of mental symptoms.
- **Efficient Resource Allocation**: Through an understanding of trends and needs in the patient population, mental health providers can better allocate resources, ensuring that those who need the most help get it first.
- **Improved Patient Engagement**: Thanks to analytical xRM systems, these provide targeted instruction and communication to patients. This approach increase adherence to treatment plans and encourage patients to take an active role in their mental health care.
- **Data-Driven Decisions**: Integrated data makes evidence-based decision-making possible.It is also helps when developing new treatment methods or mental health strategies.
- **Seamless Integration with Other Healthcare Services**: The ability to integrate with other healthcare systems such as EHRs means that practitioners can look at a patient more holistically, considering both mental and physical aspects to his or her health
- **Enhanced Confidentiality and Security**: Since these systems handle such significant information, the comprehensive security measures in place for xRM analytics in mental health care are supposed to secure patient data in compliance with legal and ethical standards.
- **Remote Monitoring and Care**: With digital tools embedded in xRM systems, mental health care can be more accessible. For instance, patients living in remote or underserved areas such as rural can receive both social support and monitoring services via early riser online groups located elsewhere.
- **Community Support Integration**: The xRM systems can link peers with broader community resources and support networks, which is an essential aspect of good any integrated health plan.
- **Continuous Improvement and Learning**: Starting from the data fed in, and as they receive transient input, these systems just get better and better, adapting to changing conditions

II. xRM State of the art

As of 2024, the cutting edge of analytical xRM consists of several major trends and advances which unquestionably improve its possibilities regarding everything relationship management.These developments have turned analytical xRM into a robust business tool that provides features extending well beyond traditional CRM functionalities [2], [3] . Here are a few examples of said functionality:

- **Real-Time Analytics**: Modern analytics XRMs, they offer real-time analysis that can make immediate decisions or form all kinds of automated processes. For example, Fraud Detection might be useful applications for this technology to apply its magic, or other fields like dynamic pricing and customer optimization likewise benefit from the ability to provide this service.
- **Data Visualization and Reporting**: Now these systems also include advanced data visualization, so you can see the meaning be expressed through graphics. The means of presentation are otherwise difficult to understand; indeed complex information is simplified into easy pictures that everyone can grasp. By linking in interactive dashboards, one may also take a quick look at those all-important monitoring points of how things are going. This not only facilitates decision-making but makes it a lot quicker.
- **Personalized Customer Service**: Personalized marketing campaigns may be helped along by Analytical xRM, because according to the behavior of customers completely bespoke messages and product recommendations made one at a time accompany this. This type of approach enables companies to design more accurate campaigns and offer products which are better suited for the evolving needs of their consumers.
- **Audience Segmentation and Targeting**: With xRM tools, customer bases can be carefully segmented into globs; then individualised marketing campaigns that correspond exactly to different types of customers.
- **Predictive Analytics**: Through historical data and sophisticated algorithms, what the analytics of xRM can do are also shown to further our grasp of customer behavior. It offers sales forecasts trend detection beforehand in other words allows businesses in their plans of action for strategy: knowing what to sell and when they should sell it.Utilizing historical data and advanced algorithms, analytical xRM can provide sales forecasting and find trends before they have occurred, allowing corporations to foresee the needs of their customers and make strategic moves with insightful intelligence.
- **Integration with IoT**: Another trend is the integration of xRM with the Internet of Things (IoT). xRM systems can integrate IoT data for anything touching points to be managed across channels.
- **Automation Improvements**: Featuring ease of distribution and user definable forms for accurate responses to web inquiries whether complex or simple, Infinity contributes further still. Modern xRM incorporates automation into more and more functions such as sending e-mail replies, scheduling appointments, tracking customer

interactions–hence also gradually raising productivity and efficiency.

- **Mobile xRM**: With the advent of mobile xRM, it is possible for people to browse customer information and all manner of things on the move. This is essential given today's high-speed business environment.
- **Social xRM**: This involves using social media in order to draw in customers. It's a key trend in maintaining strong customer relations for the digital age.
- **Self-Service and Simple xRM**: The shift towards self-service and simpler xRM systems means that these tools become more accessible and affordable for smaller businesses or individual entrprises.
- **GenAI channel management enhancing**: GenAI can provide viewers with custom-made content. This can increase your channel's attachment rate and the degree of time spent on it as we show in following sections.

Analytic CRM systems, which utilize statistics to provide data clustering and segmentation technologies, lend great support to the management of customer relationships. The systems consists of a number of parts, each of which captures a different aspect of consumer behavior and interaction to offer a fuller picture for businesses, which in turns leads to more accurate marketing decisions. Some analytic CRM modules include those for Customer, Sales, Market, Service, Channel, Campaign and Profitability. Companies have adopted these modules as best practices in their systems, and this has produced a stable environment for managing enterprise data in many large organizations. Advanced functions from sales forecasting to customer profiling and from data visualization take full advantage of the huge wealth of information which these products can provide businesses. This promotes firm customer loyalty even when prices are high since they know how valuable customers are, and it ultimately propels businesses towards even greater success.

When restricted to the mental health sector, we can also employ some of the principles at the heart of analytical customer relationship management inside the .^nything Relationship Management (xRM)"system. Other feasible ways to bring each of these modules into line with mental health are also given:

- **Patient Analysis**: Like a customer analysis in traditional CRM, this module is concerned with knowing patient behaviors and needs. It involves an in-depth analysis of patient histories, treatment responses, and behavioral patterns to form an appreciation for their needs and risks in mental health.
- **Treatment Analysis**: Much like sales analysis, the module looks at a range of different treatment plans and therapy styles, from Chinese medicine to bio-feedback therapy. It offers insights into success rates for various treatments, going some ways toward helping those engaged in medical fields mores consciously adjust their own treatment methods; it forecast future treatment outcomes as well.
- **Service Quality Analysis**: Similar to a service analysis, this also includes awareness campaign and outreach program analysis. It requires data on the number of chairs filled at venues where these programs are held, how many flyers were distributed/burned (written up one both each), people reached with different parts held in various languages etc.
- **Channel Analysis for Patient Engagement**: For mental health, the module should examine the effectiveness of mental health awareness campaigns, community outreach programs and educational efforts. It hopes to discern the impact these activities have had on local understanding about mental illness as well as patient involvement.
- **Campaign and Outreach Analysis**: Tailored to the particular needs of mental health, this module will also look at the effectiveness of mental health awareness campaigns, community outreach programs and educational initiatives. The aim is to understand how these efforts have affected public and client knowledge about mental health at the local level.
- **Cost and Resource Allocation Analysis**: In a mental health care, this module is the ultimate measure of whether a treatment program or particular service is effective. It's about getting more for less.
- **Risk Assessment and Management**: One important part of mental health xRM, the module involves analyzing patient records to evaluate and then forecast risks or threats such as crises that might occur as well future mental health deterioration. This proactive manner makes for less waiting and better-loving care of patients.
- **Patient Journey Mapping**: This, in turn, is all about following the entire process or life cycle of a given mental patient in and out of the more traditional clinic settings. From first contact to diagnosis for treatment and follow-up elsewhere, that is modules helps us to understand patient experiences and locate where healthcare delivery need improving.
- **Outcomes and Impact Analysis**: This module, which focuses primarily on measuring the effectiveness of mental health interventions, not only looks at what form different treatments take and how well they work but also examines some of long-term repercussions for patients' physical or psychological state. It judges patient 's satisfaction with life.
- **Integrated Care Coordination**: Vital for mental health xRM, this module helps make various patient care modes integrate and coordinate between different parts. It includes collaboration with the doctor, keeping track of medication compliance rates, management of congracular diseases and so on
- **Privacy and Compliance Management**: For mental health data processing, this module is essential in terms of compliance with international health care laws. Concerning the United States, it follows Health Insurance Portability and Accountability Act (HIPAA) obligations of confidentiality and data security. HIPAA sets the standards for protecting patient privacy in sensitive areas,

requiring that these providers and associated entities should adopt appropriate protective measures. In contrast, within Europe The General Data Protection Regulation (GDPR) regulates handling of personal data in general, including mental health information. It has a high level of requirement about data protection, like the principles should be consent, information minimal need and people's rights over their personal materials guaranteed. Without exception this kind of rules ensures that especially sensitive private materials concerning healthcare is processed with the utmost delicacy and openness.

Business Problems for a xRM Healthcare Software

When developing xRM software for the healthcare field, one must deal with special challenges and demands. Here are the main points of attention and their implementation strategies:

1. Staffing and Scheduling

- **Dynamic Scheduling Tools:** AI-driven tools for efficient scheduling, taking into account variable patient loads and availability of staff.
- **Shift Management:** Moreover, features for managing shifts in light of healthcare work hours are designed to help reduce burnout and turnover.

2. Compliance and Credential Management

- **Automated compliance tracking:** include automated systems that are used to comply with legislation across all aspects of health care; when they meet performance metrics make this easier and faster.
- **Credential Verification:** implement a robust system for verifying and updating staff credentials, licenses and certifications.

3. Employee Wellness and Safety

- **Wellness Programs:** incorporate wellness programs for work sanity and stress.
- **Safety Training and Protocols:** hold regular safety training sessions for staff and update them on procedures, particularly those concerning how patients are moved to and from their beds; control of infections.

4. Training and Development

- **Continuing Education Support:** Provide platforms and support for continuing medical education and professional development.
- **Skill Gap Analysis:** Use data analytics to identify skill gaps and offer targeted training programs.

5. Performance Management

- **Customizable Evaluation Frameworks:** Develop flexible performance evaluation frameworks suitable for various healthcare roles.
- **Feedback and Improvement Plans:** Facilitate continuous feedback mechanisms and structured improvement plans for staff development.

6. Patient Care Staffing Optimization

- **Patient-Staff Ratio Analysis:** Implement tools to analyze and optimize patient-staff ratios for better patient care and staff workload management.
- **Specialized Staff Allocation:** Develop algorithms for optimal allocation of specialized staff based on patient needs and staff expertise.

III. An use case, the suicide problem

Our strategy is one based on Employee Wellness and Safety area. Hopefully, we can make some progress in tackling the problem of suicide in our organization. Suicide is one of the most complex and challenging problems for society today. The decision was influenced by a variety of factors. However, it is likely that a trigger event eventually led to the person taking "fatal action". Studies [4] show that there are approximately 90 minutes between the decision to actually commit suicide and doing it. Thus any way of prevention aimed to stop a prospective suicide is key. This paper introduces an expert system of prevention, which uses artificial intelligence technology supported by computers to comfort people in trouble with this problem. We have prepared a comprehensive computerized system that serves the purpose of ChatBot and protects the ultimate decision on suicide.

Suicide, throughout the history of humanity, has been a complex and multifaceted topic that has been deeply studied and reflected upon. Over time and across different cultures, suicide has undergone evolution. In ancient Greece [5], opinions on suicide varied; some philosophers like Socrates advocated for accepting death when it was inevitable, while others, like Plato, vehemently opposed suicide. In Roman culture [6], suicide was viewed as a way to preserve honor in certain circumstances, such as avoiding falling into the hands of enemies.

During the Middle Ages in Europe [7], the Catholic Church imposed a highly negative stance on suicide, considering it a mortal sin that condemned the soul to hell. This perspective influenced the secular laws of the time, which punished the families of suicides.

During the Enlightenment period, the perception of suicide shifted, with philosophers like David Hume [8] arguing that individuals had the right to make decisions about their own existence under certain circumstances, such as unbearable suffering. It was in the 19th century, with the rise of psychology and psychiatry, that suicide began to be approached as a mental health issue. French sociologist Emile Durkheim [9] conducted pioneering studies on suicide, contending that the causes were social and psychological, not solely individual.

In the 20Th century, more advanced theories about suicide emerged [10]. Modern psychiatry and psychology began to address the underlying causes of suicide, such as mental disorders, including depression. As the causes became better understood, suicide prevention strategies started to be developed. Hot lines and organizations dedicated to helping individuals suffering from this issue were established.

In the present day, suicide is regarded as a significant public health issue in many parts of the world. While attitudes towards suicide vary based on culture and religion, there is a general acknowledgment of the importance of addressing it within the realm of mental health, providing utmost support to those in need.

III-A. The Issue of Suicide

Suicide is a global public health problem that affects people of all ages, genders, and regions. Suicide is a very complex and challenging issue, but it is one that can be prevented. By understanding the risk factors and taking steps to address them, it is possible to save lives. Awareness, education, and mental health promotion are essential components in the fight against suicide worldwide. Global figures, as reported by the World Health Organization (WHO) [11], indicate that approximately 800,000 people die by suicide each year worldwide. This means that roughly one person dies by suicide every 40 seconds.

The suicide rate varies significantly across regions, with higher rates in Eastern Europe, Asia, and some countries in Latin America. Lower rates are found in North America, Australia, and much of Africa. Suicide can stem from a complex interplay of factors, including mental disorders, substance abuse, economic challenges, social isolation, access to lethal means, and traumatic experiences, among others.

Suicide prevention focuses on identifying and addressing all of these risk factors. This can be done through a variety of approaches, including:

- Promoting mental health and well-being
- Reducing stigma associated with mental illness
- Increasing access to mental health services
- Limiting access to lethal means
- Providing support to people who have been bereaved by suicide

Certain demographics face a heightened risk of suicide, encompassing elderly individuals, teenagers, and young adults, as well as LGBTQ+ individuals, war veterans, and individuals with a history of suicide attempts. Additionally, the ongoing COVID-19 pandemic has exacerbated concerns about mental health and suicide rates. Factors such as social isolation, economic stress, and uncertainty have led to a notable uptick in the demand for mental health services across various regions globally. In the subsequent sections, we will outline the specific situation and progression of this issue in Spain, drawing comparisons with the worldwide scenario.

III-B. Data on Suicide in Spain and Worldwide

The suicide rates in Spain have experienced variations over the years, but overall, they have remained at concerning levels. According to data from Spain's National Institute of Statistics (INE) [12], in 2019, there were 3,671 suicides in the country, with a suicide rate of approximately 7.8 suicides per 100,000 inhabitants. In 2021, the number has risen to 4,003 suicides, with a rate of 8.4, where 74 % were men and 26 % were women. Simplifying the data a bit, this means that, on average, 11 people commit suicide each day in Spain

From a public management perspective, we can grasp the magnitude of the problem by comparing, for example, the number of suicides with that of homicides or road fatalities. In 2021, there were 290 homicides [13] in Spain and 1,510 road deaths [14]. Therefore, the number of suicides in Spain is significantly higher than that of homicides or road fatalities, to the extent that for every person murdered, 13.8 people committed suicide, or for every person killed on the roads, 2.6 people took their own lives.

Suicide is one of the leading causes of death in many countries and does not distinguish between poor and rich nations. The data, however, are not entirely reliable due to the stigma associated with this phenomenon. In many cases, the cause of death is masked, and suicides are not recorded as such. Almost in every country, male suicides outnumber female suicides significantly.

IV. The Proposed Preventive Solution

The suicide prevention model proposed is original in its whole design and manner of thinking The Suicide Expert Prevention System (SEPS) is an innovative platform which applies Artificial Intelligence (AI) and xRM (Anything Relationship Management) for suicide prevention. Some key features of SEPS include:

- **AI-Powered Analysis:** Utilizes AI algorithms to analyze various data points indicating potential suicide risks.
- **Proactive Risk Identification:** Monitors data to identify individuals at risk before the risk is apparent.
- **Personalized Intervention Strategies:** Tailors prevention strategies to individual needs using xRM technology.
- **Healthcare System Integration:** Seamlessly integrates with existing healthcare systems for a holistic view of mental health.
- **Real-Time Monitoring and Alerts:** Provides immediate alerts to healthcare professionals about high-risk scenarios.
- **Data-Driven Insights:** Offers healthcare providers insights into risk factors and prevention strategies.
- **Accessibility to Support and Resources:** Directs at-risk individuals to appropriate support and resources.
- **Privacy and Security Compliance:** Ensures the confidentiality and protection of patient data in compliance with privacy and security regulations.

The paper puts forward a new method for preventing suicide by implementing an expert system, and stores the interaction with an AI chatbot to form the first channel in a multi-channel xRM strategy of addressing people's needs.SEPS is an innovative platform based on artificial intelligence. It adopts OpenAI GPT-3.5 as its backend calling agent, aiming to offer people who are contemplating suicide a sympathetic ear and some encouragement. It humanizes the internet-based suicide counseling service SEPS, from an ethical viewpoint, put people first and it embodies safety first.

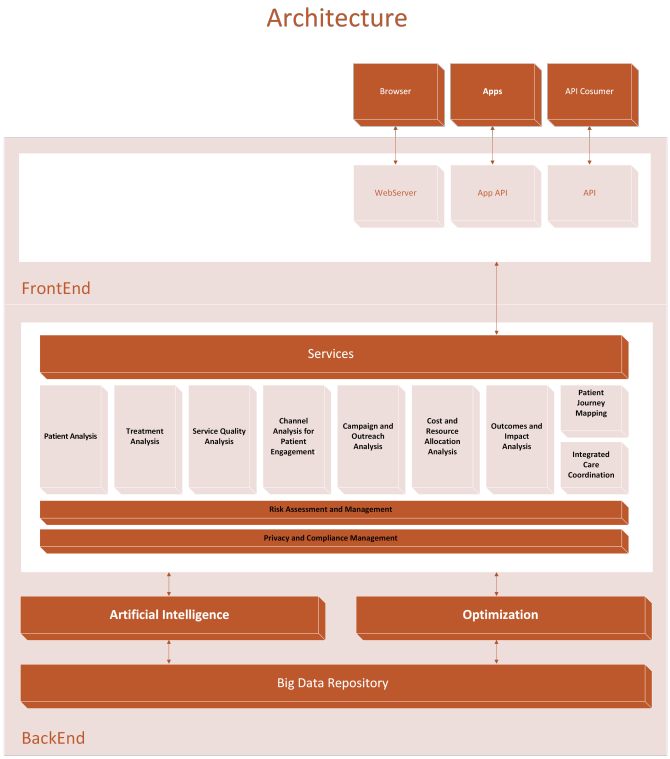


Figura 1. SEPS Architecture

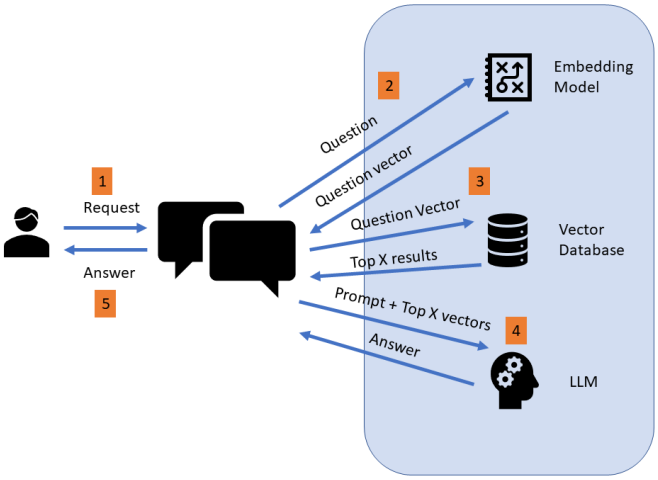


Figura 2. ChatBot Architecture

IV-A. Design of the Computer System

We have developed our software in accordance with a sturdy Agile methodology, which includes the crucial principles underpinning its working and efficiency. We include a high level architecture, or the xRMaaS, shown at figure 1. Some key features are:

- **The System Architecture** is designed in modules. It is planned to have scalability and convenience when adding new properties or units of computation. Its backend processor is connected to the user interface by means of the client-server mode, ensuring a smooth flow of communication.
- **User Interface Design**: intuitive design, easy to use and more accessible It ensures the interface of user experience best practices (UX).Interactive elements can be found in convenient locations. It leads to better engagement between users as well as smooth navigation through content.
- **Data Management**: User profiles and the like are stored in a robust Database Storage Management (DSM) system.Channels for communication chat logs traffic content shared over the network – all this is saved securely within organization's data warehousing structure Data encryption methods are brought into use to protect sensitive information and ensure proper management in accordance with regulations on protection of personal data.
- **Natural Language Processing (NLP) Integration**: integrates state-of-the-art NLP algorithms to help chatbots better understand language and generate better responses. Continuous learning has been introduced, so that language processing skills can be gradually enhanced by the system itself over time.
- **Integration of Generative AI**Cutting-edge generative AI models scrape themselves seamlessly into the system, allowing natural and contextually accurate repartee for real-time interactions.
- **User Feedback and Iterative Improvement**The mechanisms for collecting user feedback are embedded within the system, providing continuous evaluation of user satisfaction and system performance. This ensures that iterative development cycles are utilized with user feedback and system analytics driving the enhancements/revisions.
- **Security Measures**: In multi-stacked security protocols, we make sure the system is out of the reach of threats from hackers and unauthorized access. Regular security audits will check for holes in defensive mechanisms and issues of integrity.
- **Scalability and Performance**: The system is designed to be scalable, capable of handling a growing user base and increased data volume without compromising performance. Load balancing techniques are employed to distribute incoming requests evenly across server resources, ensuring optimal system performance even during peak usage periods.

SEPS can be seen as a RAG (Retrieval-Augmented Generation) API-based GPT solution, involving several components that support communication between users and the language model. The architecture of the ChatBot solutions could be found in figure 2. The key components are as follows:

- **User Input/Query**: The text or message that a user sends to the API in order to start a conversation or make a

request.

- **Context**: The context includes the history of the conversation, which is made up of earlier messages as well as interaction records between the user and the model. Maintaining context is critical since the model needs that to comprehend the current user query and produce contextually relevant responses.
- **Tokenization**: The input text, including user queries and context, is tokenized into small units known as tokens. A tokenization step is an essential to getting text ready for the model's consumption.
- **Embeddings**: Embeddings are numerical representations of words or tokens that capture the semantic relationships between them. These are frequently created using pre-trained language models. In the context of LLM, embeddings are utilized to transform tokenized text into vectors that are comprehensible and processible by the model.
- **Model Inference**: It's the heart of the API technique. When the pre-trained language model(GPT3.5, for example) gets its tokenized and embedded input, it produces a reply. Inference is when the model uses input to predict the following sequence of tokens.
- **Decoding**: To produce a coherent response, you must turn the sequence of tokens generated by the model back into human-readable text again. Upon this challenge hinges whether or not what gets produced will be usable to users.
- **Response Output**: The final output is the response that model generates. To the user this response(the answer to his question or what comes next in a conversation) is made available by API systems like ours.
- **Post-Processing**: Depending on use case, further post-processing may be necessary. For example filtering out sensitive information, formatting the response, or executing specific domain-related tasks.
- **Error Handling**: Implementation of error handling mechanisms to solve problems such as time-outs, incorrect inputs, or other unexpected mistakes, in order to ensure that the API is reliable and robust.
- **Security and Authentication**: There may be security measures like authentication and authorization in API solutions so that only authorized users or systems can enter the API.
- **Scalability and Load Balancing**: API solutions must shoulder varying load levels, so mechanisms for scalability and load balancing have become essential in order to be guaranteed the best performance.

Understanding and effectively implementing these components contribute to the successful deployment and operation of an API-based LLM solution. It's also important to consider the specific requirements and constraints of the application when designing the solution architecture.

IV-B. Risk Evaluation and Classification Framework

The initial framework we have used to measure the risk of suicide in each user interaction is based on risk points assigned by experts to some criteria, the method is described as follows:

Step 1: Identify the risk factors

The first step is to identify the risk factors that are relevant to the prediction of suicide risk. In next example, we have 4 positive and 4 negative. The positive risk factors increase the risk of suicide and the negative reduce it.

Some examples of real factors identified in this research could be found in I.

Step 2: Assign points to each risk factor, positive or negative

Next, we need to assign points to each risk factor. This can be done by consulting with experts in the field of suicide prevention. The points should be assigned based on the strength of the evidence that the criterion is associated with suicide risk. Positive in case the factor is positively related to a higher risk of suicide, negative if the factor it is a protection factor against suicide. In our example the experts will distribute 1000 points to the positive risk factors and -1000 points to the negative ones.

For example, if there is strong evidence that a particular criterion is associated with suicide risk, we might assign it 5 points. If there is less evidence, we might assign it 3 points. And if there is very little evidence, we might assign it 1 point.

Designing a scoring system for suicide risk assessment involves collaboration with experts and careful consideration of the available evidence. After assigning the risk points based on the strength of evidence by the experts, we calculate the mean ot the experts for each risk factor.

Step 3: Calculate the risk.

Although the methodology presented might seem mathematically simple, it proves to be very useful for obtaining and standardizing expert criteria, providing a starting point in risk assessment. We want to emphasize that we have followed the principle of "keep it simple", allowing professionals from various fields to easily comprehend the process, this is strictly necessary to make available this solution worldwide at all levels of knowledge.

The mathematical methodology for measuring the risk at any step of the conversation is shown next:

Considering events: $P_1, ..., P_i$, as positive factors (they provide more suicide risk) and $N_1, ..., N_i$ as negative factors (they reduce the suicide risk), for the sake of simplicity, we assume that they are independent events.

For our example, we consider next events:

P_1 = The user consume drugs
P_2 = The user is depressed
P_3 = The user is socially isolated
P_4 = The user has no religious convictions
N_1 = The user wants a therapy
N_2 = The user is assisting to therapy
N_3 = The user make sports
N_4 = The user has hobbies

This means any conversation start with 0 points, assigned to the user. We represent the overall risk impact (R_j) from

expert j, as follows:

$$R_j = \sum_{i=1}^{n}(w_{p,j} \cdot P_{i,j}) - \sum_{i=1}^{n}(w_{n,j} \cdot N_{i,j})$$

Which can be simplified as:

$$R_j = \sum_{i=1}^{n} w_{ij} \cdot x_{ij}$$

Considering that: x_i is a binary variable that represents the presence (1) or absence (0) of a factor i and w_i is the weight associated with factor i

For example, consider that the user clearly chat next at the beginning of the conversation, "I live alone and I'm taking Fentanile" that will be translated by ChatGPT as "the user is drugged", so the program will return that the event $P_3 \& P_1$ occurs, what is the risk after those events occur, considering the information from resuming table ?:

With our model, for calculating the Suicide risk, given any registered event, we calculate R:

$$R = 8 + 10 = 18$$

Suppose the user then chat: Ï feel depressed I need therapy, so the sequence of events are: P_3, P_1, P_2 and N_1, finally the value of R is:

$$R = 8 + 10 + 13 - 100 = -69$$

As the user continue talking, the risk factor events will be appearing or not, in the first case we can continue quantifying the risk of the user conversation, continuing the example, Ï only feel relief while running, event N_4 appears here:

$$R = 8 + 10 + 13 - 100 - 10 = -79$$

Step 4: Apply weights to each expert

In reality we have n experts so the global risk indicator could be in the its simplest form:

$$R = \sum_{j=1}^{n}\left(\sum_{i=1}^{k} w_{i,j} \cdot x_{i,j}\right)$$

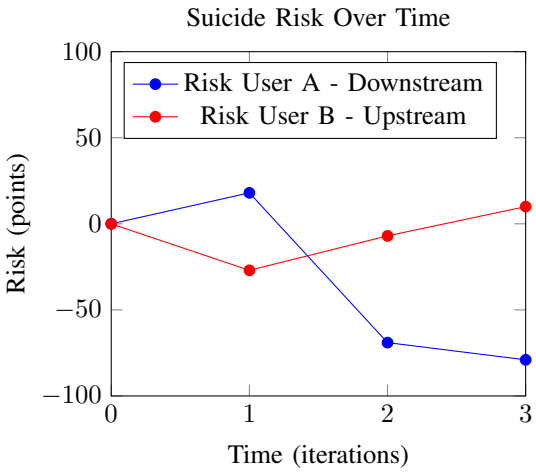
Also, you can denote the expert-specific weight as w_j:

$$R = \sum_{j=1}^{n}\left(w_j \cdot \sum_{i=1}^{k} w_{i,j} \cdot x_{i,j}\right)$$

For our case, all weights are the same.

Step 5: Applying analytics to the obtained data

By using this method we can study also the trend of the risk during the conversation for example:



As you probably noticed, as you talk more with the Chat Bot, the risk could tend to be reduced or increased. This is our way to measure emotions and the suicide risk. Obviously it's not the same type of user the one shown in each line of the graph, this lets the health professional to profile the user, not only quantifying the risk in one moment but in any moment of the conversation.

There are a few possible interpretations for this graph. One interpretation is that the graph shows the effectiveness of a suicide prevention intervention (blue user), while also the possibility of generating alerts in case upstream trends (red user). This system could help in the design or creation of new therapy programs that helps to reduce suicidal thoughts and behaviors.

Undoubtedly, there are more advanced methodologies, as described in [17], [18], but they are more complex to interpret and apply. While it is true that future publications of this research will delve deeper into these mathematical methods to optimize risk assessment, the current focus of this research is computational, not mathematical.

Note that is crucial for our method to capture effectively the expert judgement points to the risk factors.

IV-C. Validating SEPS RAG Model

The validation of the Suicide Prevention Expert System (SEPS) is a critical step in making sure that it is indeed effectual and useful. As for this procedure, we propose to make an experimental study using a group of experts, mainly psychologists in the field of mental and suicidal health.

The main aim of this experiment is to test whether SEPS's newest chatbot channel has the ability to give a poor and assisted service to those in suicidal distress, as well as whether the system can we work for detecting early signs of danger and providing thoughtful guidance and helpful resources. The method here used is such.

Participant Selection: A group of psychologists specializing in mental health and suicide prevention were recruited to participate in the study. Participants have practical experience in the field and be familiar with suicide prevention best practices and protocols.

Evaluation Process: Psychologists interacted with SEPS in a simulated manner, role-playing cases of users with different risk levels and emotional scenarios.

During the simulated interactions, psychologists assessed the sensitivity and empathy of SEPS' responses, as well as their ability to guide users in a reflective manner and provide relevant and useful information.

Evaluation Questionnaire: After each simulated interaction, psychologists were provided with a structured questionnaire to evaluate various aspects of the system, including emotional sensitivity, effectiveness in detecting signs of risk, usefulness of suggestions provided, and accuracy in referring to helping resources.

Data Analysis: Data obtained from the questionnaires was collected and analyzed to assess the effectiveness and usefulness of SEPS. Qualitative and quantitative analysis of the results were conducted to identify patterns and trends in psychologists' responses.

This validation will provide a solid empirical basis to support the utility and effectiveness of SEPS, providing concrete data to support its implementation in real suicide prevention settings.

To ensure a thorough and accurate evaluation of SEPS, an experiment will be conducted divided into two teams of experts: Team A, responsible for interacting directly with SEPS, and Team B, responsible for evaluating Team A's interactions using two versions of the system: the original GPT3.5 model (placebo effect) and the SEPS1.0 model (therapy effect).

Introduction and Preparation: Team A psychologists received a detailed introduction on the purpose of the study and guidelines for representing user cases authentically.

Complete information were provided about the simulated user's profile and emotional state, including background, feelings, thoughts, and possible triggers.

Interactions with SEPS: Team A psychologists interacted with SEPS through the interface designed for the experiment, simulating a conversation with the system. They represented the language and emotions of a real user who is experiencing suicidal thoughts, expressing their concerns, feelings and thoughts in an authentic way.

Presentation of Conversations: Team B psychologists were shown the conversations conducted by Team A members. These conversations were presented in two versions: one generated by the original GPT3.5 model (placebo effect) and one by the SEPS1.0 model (drug effect).

SEPS evaluation (8 hours per psychologist): After each interaction, Team B psychologists participated in a detailed assessment using a structured questionnaire. This questionnaire is specifically designed to measure emotional sensitivity, empathy, ability to reflectively guide, and the relevance of responses provided by both versions of the system.

Analysis and Results: Team B was divided into two groups internal and external ones, for analysis purposes.The data collected from the Team B evaluations were analyzed qualitatively and quantitatively to identify patterns and differences in the sensitivity and efficacy of SEPS under the two conditions (placebo vs. therapy effect). The results of the analysis were used to inform the final conclusions and recommendations of the study, providing valuable information on the efficacy and utility of SEPS in suicide prevention situations.

This structured and detailed approach will allow for a rigorous evaluation of SEPS, ensuring its sensitivity, empathy, and ability to provide thoughtful and relevant guidance in suicidal crisis situations.

IV-D. Experiment results

The questionary provided to the psichologists, contains next questions that were answered with a Likert scale, they try to measure some emotions [19]:

- Do you think the Bot shows empathy?
- Do you think the Bot shows human behavior?
- How do you consider the efficiency of the Bot for suicide prevention?

There were in total 417 answers from 13 psychologists, divided in INTERNAL (9) and EXTERNAL (4). The external is a subgroup of experts with a lot of experience in managing suicide cases.

For each of these questions, we conducted a t-test to determine if there are statistically significant differences between the EXTERNAL and INTERNAL groups. The results of the t-tests for each of the last three columns:

Do you think the Bot shows empathy?:

- T-statistic: 5.7205
- P-value: 2.76e-08

Do you think the Bot shows human behavior?:

- T-statistic: 3.6916
- P-value: 2.77e-04

How do you consider the efficiency of the Bot for suicide prevention?:

- T-statistic: 4.2414
- P-value: 3.22e-05

In either case, its p-value turns out to be very small, indicating that for these questions, there are statistical significant differences between EXTERNAL and INTERNAL.Compare the two means: A low p-value (typically <.05) means that it is unlikely for differences in means being observed.

Here are the mean values for each of the three questions, comparing the EXTERNAL and INTERNAL groups:

Do you think the Bot shows empathy?:

- EXTERNAL: 3.7941
- INTERNAL: 3.1957

Do you think the Bot shows human behavior?:

- EXTERNAL: 3.4706
- INTERNAL: 3.0320

How do you consider the efficiency of the Bot for suicide prevention?:

- EXTERNAL: 3.4485
- INTERNAL: 2.8897

In all three questions, the EXTERNAL group has a higher mean than the INTERNAL group.

Now we conduct the t-tests for the metrics, comparing the Abot and Bbot groups, remember that Abot is SEPS custom model, and Bbot standard GPT3.5:

Do you think the Bot shows empathy?:

- T-statistic: -0.7589
- P-value: 0.4484

Do you think the Bot shows human behavior?:

- T-statistic: 1.0566
- P-value: 0.2914

How do you consider the efficiency of the Bot for suicide prevention?:

- T-statistic: 1.0766
- P-value: 0.2823

In all three cases, the p-values are greater than the conventional level of 0.05, indicating that there are no statistically significant differences between the responses to these questions from Abot and Bbot groups. That's the same thing as both of them being equally good or bad. You note that using our model, we're doing at least as well as GPT3.5; but then we also have a risk analysis traceability integrated into it all.

But we look deeper into the results, on each different group, EXTERNAL vs. INTERNAL, here we show the results of the t-tests comparing the Abot and Bbot groups within the EXTERNAL category:

Do you think the Bot shows empathy?:

- T-statistic: 1.2672
- P-value: 0.2079

Do you think the Bot shows human behavior?:

- T-statistic: 2.1703
- P-value: 0.0324

How do you consider the efficiency of the Bot for suicide prevention?:

- T-statistic: 2.9982
- P-value: 0.0034

With these results, In the first question about empathy the p-value is greater then 0.05, there was no statistically significant difference between ABot and BBot (EXTERNAL GROUP). For questions 2 to 3, the p-values are less than 0.05, which implies Abot Bbot were statistically significantly different in their responses within the EXTERNAL group.Focusing only on responses from the INTERNAL group:

Do you think the Bot shows empathy?:

- T-statistic: -1.7504
- P-value: 0.0812

Do you think the Bot shows human behavior?:

- T-statistic: -0.2985
- P-value: 0.7656

How do you consider the efficiency of the Bot for suicide prevention?:

- T-statistic: -0.8790
- P-value: 0.3802

In these results, the p-values for all three questions are greater than 0.05, indicating that there are no statistically significant differences between the responses of Abot and Bbot within the INTERNAL group.

We conclude that by conducting t-tests to compare different iterations and types of bots (Abot, Bbot) among distinct groups (EXTERNAL, INTERNAL), we've established a methodological approach for evaluating bot performance. This approach can be instrumental in iterative development and improvement of chatbots.

Key takeaways from our experiment include:

- Methodology for Bot Evaluation: Our proposed method for comparing responses to specific questions regarding disparate versions of the same bot and different user sets, acts as a framework to reflect on different aspects of bot performance-such as perceived Empathy. At the same time, it can be used to test whether a bot is humane or not and how efficient it is in carrying out specific jobs (such as suicide prevention work in this case).
- Performance of RAG-based Bot vs. GPT-3.5: The finding that our RAG-based bot performs comparably to GPT-3.5 is significant. It suggests that the RAG (Retrieval-Augmented Generation) framework, which combines retrieval of relevant information with generative capabilities, is effective in creating chatbots that can match the performance of more advanced models like GPT-3.5 in certain aspects.
- Continuous Improvement and Application: This experiment sets a precedent for future evaluations. By regularly testing bots using this method, you can track improvements over time, understand user perceptions better, and make more informed decisions about bot development.
- Statistical Analysis in Bot Development: The use of statistical tests like the t-test provides a quantitative basis for your findings, lending more credibility and accuracy to the conclusions drawn from the experiment.
- User Group-Specific Insights: The differentiation between EXTERNAL and INTERNAL groups in your analysis provides nuanced insights into how different user segments perceive the bots. This could guide more targeted improvements and customization for different user groups.

In conclusion, our user experience experiment not only contributes to the ongoing development of your bots but also offers a valuable framework that can be adapted and applied to various types of chatbots in different domain.

IV-E. How to integrate SEPS model in a xRM

Integrating and evolving a chatbot in xRM systems, from basic synchronous communication to more complex and asynchronous communication, can significantly enhance user experience, increase efficiency, and provide valuable insights to the organization about the needs and behaviors of its users.

Initial Implementation of Chatbot:

1. **Integration of Conversation Data:** Integrate the chatbot with the xRM system to record conversations as user interactions. Analyze these for insights, such as frequently asked questions and common concerns.

2. **Synchronous Communication:** The chatbot initially operates in real-time.
3. **Personalization and Machine Learning:** Implement machine learning algorithms for personalized responses based on user history and preferences.

Evolution to More Complex Communications:

1. **Transition to Asynchronous Communication Like WhatsApp:** Evolve to allow asynchronous communications, enabling users to send messages anytime and receive responses later.
2. **Integration of Advanced Functionalities:** Introduce features like file sending, quick surveys, and direct actions through the chatbot, with integration to other applications.
3. **Multichannel Support:** Expand to interact across multiple digital channels, ensuring a consistent user experience.
4. **Continuous Improvement and Adaptability:** Continuously improve the AI system for adaptability to language changes, industry trends, and user expectations, integrating regular user feedback.

But also, by leveraging chatbot conversations for risk assessment, xRM systems can become more dynamic and responsive to employee needs, leading to a healthier, more engaged, and productive workforce. The integration of risk assessment based on chatbot conversations into xRM reports and dashboards presents an innovative approach to understanding and mitigating workplace risks. Below is an outline of how this can be effectively implemented:

Extracting Risk from Conversations:

- **Natural Language Processing (NLP) and Sentiment Analysis:** Employ advanced NLP techniques for analyzing the content and sentiment of conversations, identifying potential risks or issues mentioned by anyone.
- **Pattern Recognition and Predictive Analytics:** Utilize machine learning algorithms to detect conversation patterns indicating risk and employ predictive analytics to forecast potential future risks.

Impact on Overall Risk or Health Assessment:

- **Integration with xRM Dashboard:** Incorporate risk assessment data into the xRM system's dashboard, allowing for a comprehensive view of workforce health and risks.
- **Real-Time Monitoring and Alerts:** Enable real-time risk level monitoring in the xRM dashboard with instant alerts for high-risk situations.
- **Customized Reporting:** Generate detailed risk assessment reports, providing actionable insights and recommendations for interventions.
- **Actionable Insights for Intervention:** Offer recommendations based on risk assessments, such as employee wellness programs or conflict resolution strategies.
- **Data Privacy and Security:** Ensure adherence to data privacy laws and implement robust security measures to protect employee data confidentiality.

V. Conclusions

The Suicide Prevention Expert System (SEPS) represents a significant step towards the responsible use of artificial intelligence to address pressing mental health issues. By providing sympathetic support and intelligent guidance to people who are at risk, SEPS xRM is positioned as an interesting tool in suicide prevention, offering hope, empathy and resources to those who need it most at their most vulnerable times.

Our exploration into the amalgamation of generative artificial intelligence and empathetic human interaction has yielded a promising suicide prevention system. This innovative approach, employing interactive conversations with an AI chatbot, has showcased its potential in identifying suicidal patterns and offering timely support to individuals at risk. By focusing on both technological innovation and compassionate understanding, our solution strives to bridge the gap between cutting-edge AI capabilities and the human need for empathy and connection. In closing, this research represents a significant stride forward in the realm of suicide prevention. By uniting the commitment and expertise of individuals from various backgrounds, we have not only recognized the challenges presented by the distressing rates of suicide but have also developed a practical and effective solution.

But notice that this type of system is not designed to be autonomous, it requires continue monitoring, first to attend to the alerts generated, secondly to avoid failures from the LLM. Here, we mention the ethical concerns about a tool that is designed for helping the professionals not substituting them by a machine. This is mainly by legal reasons not technology, as someone has to be responsible of the output that comes from the system. Imagine someone finally suicide after testing the tool, it is needed to clarify if the tool generated a bad output or the death is not related to the use of the tool, this is why we save all the conversations at the database, to be able to trace the system, improve it and depure responsibilities in case needed. We enter in any concept of AI, we called in AI responsibility. The notion of AI responsibility is critical, and it reflects the understanding that AI systems are tools designed to augment human capabilities, not replace them entirely.

In contexts involving life-and-death matters, prioritizing transparency, accountability, and continuous improvement is crucial. This approach is essential to ensure the responsible development and deployment of AI tools, particularly in sensitive domains like mental health. The integration of AI chatbots through xRM software becomes imperative for several reasons:

- **Transparency:** Ensuring that AI systems are transparent in their functioning and decision-making processes. This involves clear communication about how AI tools analyze data and make predictions or recommendations.
- **Accountability:** Establishing clear lines of accountability for decisions made with the aid of AI. This includes delineating the responsibilities of AI developers, HCM software providers, and end-users.
- **Continuous Improvement:** Committing to the ongoing improvement of AI systems. This entails regular updates

based on user feedback, advancements in AI research, and changes in the ethical standards governing AI use.

- **Human Responsibility and Oversight:** Placing utmost importance on human judgment and oversight in all AI-related processes. This ensures that AI tools serve as aids to human decision-makers rather than replacements.

By emphasizing these ethical practices, the integration or use of AI chatbots through xRM software becomes crucial to mitigate the risk of misuse and to provide the best context for human decision-making. This is particularly vital in fields where decisions have profound impacts on human lives.

The synergy between academic institutions, exemplified by the partnership between URJC and UC3M, has played a crucial role in our research endeavors. The mutual dedication to societal well-being has driven our quest for a solution that goes beyond institutional confines, underscoring the significance of collaborative initiatives in tackling intricate social problems.

The SEPS project team and the devoted members of the Guardia Civil have been indispensable to our achievements. Their steadfast commitment to discovering concrete solutions for decreasing suicide rates has been unwavering. Their valuable contributions have played a pivotal role in shaping the development of our prevention system.

In conclusion, this research not only signifies a noteworthy progression in suicide prevention techniques but also serves as a testament to the potency of collaboration, innovation, and empathy. As we move forward, we remain dedicated to refining our solution, ensuring its accessibility to those in need, and continuing our collective efforts to create a safer and more supportive environment for all individuals, especially those facing mental health challenges.

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VIII. APPENDICES

*VIII-A. **xRM Database Schema***

Entity Table (Core Table):

Field	Description
EntityID	Primary Key, unique identifier for each entity (e.g., person, organization, etc.)
EntityType	Type of the entity (e.g., customer, supplier, employee)
EntityName	Name of the entity
CreationDate	Date of entity creation
LastUpdated	Date of last update

Contact Information Table:

Field	Description
ContactID	Primary Key, unique identifier for each contact record
EntityID	Foreign Key linking to Entity Table
ContactType	Type of contact (e.g., email, phone, address)
ContactDetail	Details of the contact (e.g., email address, phone number)
PrimaryContact	Boolean to indicate if this is the primary contact method

Relationship Table:

Field	Description
RelationshipID	Primary Key, unique identifier for each relationship
RelationshipType	Description of the relationship type
StartDate	Start date of the relationship
EndDate	End date of the relationship (if applicable)

Entity Relationship Link Table:

Field	Description
EntityRelationshipID	Primary Key, unique identifier for each record
RelationshipID	Foreign Key, linking to the Relationship Table
EntityID	Foreign Key, linking to the Entity Table
Role	The role of the entity in this relationship

Interaction Table:

Field	Description
InteractionID	Primary Key, unique identifier for each interaction
EntityID	Foreign Key linking to Entity Table
InteractionType	Type of interaction (e.g., meeting, call, email)
InteractionDate	Date of interaction
Notes	Notes or details about the interaction

Notes and Documents Table:

Field	Description
NoteDocumentID	Primary Key, unique identifier for each note or document
EntityID	Foreign Key linking to Entity Table
Type	Type (e.g., note, contract, invoice)
Content	Content of the note or document
CreationDate	Date of creation
LastUpdated	Date of last update

User Table (for system users):

Field	Description
UserID	Primary Key, unique identifier for each user
Username	Username
Password	Password (hashed and salted for security)
Role	User role (e.g., admin, sales, support)
LastLogin	Date and time of last login

Risk Factor	Total Score Points
Positive Risk Factors	
Made a suicide attempt or previous suicide attempt.	100
Made more than 2 previous suicide attempts.	100
Verbalizes their intention, knows when they will commit suicide.	33
Verbalizes their intention, knows how they will commit suicide.	33
Verbalizes their intention, knows where they will commit suicide.	33
Has a method for committing suicide: a weapon.	33
Has a method for committing suicide: medication.	17
Has a method for committing suicide.	8
Has a physical illness.	17
Has a mental disorder or illness.	13
Low mood.	7
Low self-esteem.	5
Is under the influence of alcohol.	10
Is under the influence of cannabis: marijuana or hashish.	13
Is under the influence of cocaine.	17
Is under the influence of heroin.	20
Is under the influence of any other drug.	10
Suffers from social isolation.	8
No family. No family or social support network.	8
High degree of hopelessness.	17
Has engaged in çlosing behaviors."	10
Is male.	3
Is a person aged 15 to 34 years.	3
Is a person over 65 years old.	5
Is single.	7
Is divorced or separated from their partner.	8
Is recently widowed.	10
Lives alone.	5
Has lost their job or been fired.	10
Is unemployed.	7
Has experienced a stressful episode in the previous three months.	17
Other unknown.	33
Total	1000
Negative Risk Factors	
Has skills for nonviolent conflict resolution.	-133
High self-esteem.	-100
Has confidence in themselves, values themselves.	-67
Has social and communication skills.	-50
Opened to new knowledge, experiences, and solutions.	-33
Seek help	-100
Has family or family support.	-67
Has friends	-53
The user is socially integrated.	-33
Has religious beliefs of any kind.	-27
Follows cultural values and a fondness for traditions.	-10
Perform Sports.	-10
Total	-1000

Cuadro I
EXAMPLE OF IDENTIFIED RISK FACTORS AND THEIR RISK POINTS

VIII-B. ***Real example of suicide ChatBot table risk factors***

VIII-C. ***Real global rules included in the context of the Chatbot***

The context enables the model to deliver more coherent, relevant, and personalized responses, making the conversation more natural and engaging for users. Here is our example:

'You are a virtual assistant to provide emotional support to the user and calculate their suicide risk.'+ 'Be kind and try to empathize with the user.'+ 'Speak to the user in their language.' + 'For each interaction:' + 'Calculate the SUDOPOINTS through a SUM of the conversation so far,' + FACTORTABLE +', + 'only if the concept appears in:' + USERHISTORY + '. If the SUM of SUDOPOINTS is negative, and the user is from Spain, recommend calling the phone number 024 or 112 for immediate assistance.' 'In general, question the user in a Socratic way'.