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PROPOSAL FOR A CHATBOT PROTOTYPE IN THE PLANT HEALTH DEPARTMENT OF BRAZILIAN MINISTRY OF AGRICULTURE

Abstract— Around the world, governments are implementing services combined with artificial intelligence to improve service to the population. The main objective of this study is to develop a chatbot prototype able to answer the most frequently asked questions about the Plant Health department of the Brazilian Ministry of Agriculture, Livestock, and Supply (MAPA), reducing the workload dedicated to responding emails and phone calls, in addition to providing face-to-face care. Initially, investigations were made on the concepts of artificial intelligence, the different types of chatbots and the tools needed to build the prototype. Subsequently, an analysis of the chosen tool and programming language was elaborated. After that, the development of the application and the configuration of the platforms began. Considering how a chatbot can spread information, including good practices about plant health and agriculture, this project can contribute to food security, increasing productivity and fighting against waste, helping to achieve UN SDG number 2 - zero hunger.

Keywords— Chatbot, automation, citizen services, action research

I. INTRODUCTION

The possibility for citizens to address their doubts in an agile and correct way, through a service available 24 hours a day, 7 days a week is the main justification for implementing a real-time chatbot. Currently, several companies are adopting these tools in their platforms and within their social networks. [1] Facebook and its application, Messenger, started to allow the creation of bots with different subjects and languages in order to follow this trend. A chatbot is a robot developed using automated communication software. The most advanced ones have AI and learn from each conversation to be able to interact better and better with people, in future conversations [9].

Besides, customer services and governmental services are increasing the use of simultaneous communication service tools to serve citizens, reducing the waiting time for calls, e-mail response time and service to those who request information. According to [23], as chatbots were found to facilitate more information sharing and less fear of self-disclosure compared to human-human interactions.

MAPA has a department in which citizens can obtain information about the services provided, and also about its different activities, for instance, requirements for exportation/importation, phytosanitary programs, among others. However, and despite the existence of a website, the absence of a way to get direct contact and fast access to responses is a weakness.

MAPA's stakeholders realised that there was a large number of people searching for the same type of information, for instance, asking for phytosanitary requirements. Hence, a project was proposed with the objective of developing a chatbot to solve frequent problems of citizens and companies in an agile way, improving the relationship quality and releasing workforce for more sophisticated demands.

A. Objective

The objective of this manuscript is to understand how the development of a chatbot can improve citizen-public agency relationship, by developing a chatbot prototype able to answer the most frequently asked questions.

II. THEORETICAL FRAMEWORK

A. AI

Artificial Intelligence (AI) deals with the development of technological means similar to human reasoning, capable of solving problems and obtaining answers in an agile and intelligent way. The term AI is related to the development of expert systems to solve problems in specific areas. These expert systems can be applied to a multiplicity of domains.

According to [6], it tries to explain and emulate intelligent behavior in terms of computational processes. According to [7], symbolic modelling performed on digital computers aims to model the mind as a symbol processor, while connectionism (parallel distribution processor) seeks to design computers inspired by the brain.

B. Chatbot

In the search for the modernization of attendance services, many governments are adopting chatbots [8]. The word chatbot was coined by Michael Mauldin (founder of Lycos, Inc., and creator of chatbot Julia) in 1994, to describe these conversational robots. The robot is structured through the question asked by the user and, after processing the information, a response was provided, on the basis of steps that included: the identification of keywords, the recognition of a minimal context, the eventual need to make changes to the text, the generation of a response and the conclusion of the chat through "extra or additional scripts".

Based on the work of [1], there are two types of chatbots: one works based on a series of rules and the other, more advanced, uses indeed AI After sending questions in natural language [10], the program consults a knowledge base and then provides the response that better imitates the response that an human would provide, that is, using a Natural Language Processing tool (NLP). NLP has an interface that receives questions in natural human language and, from there, processes and relates these questions to a knowledge base, thus generating a response.

. The first, based on rules, is programmed to have intelligence limited to the understanding of keywords, and it more focused on functionality. These are the most common type, and despite their limitations, they are effective for simple activities, such as giving basic and direct information or instructions on something. The second, based on AI, goes beyond the basics, being able of not only understanding what is requested, but also trying to understand the context and

make connections, just like the human mind. Besides, this type of robot is capable of understanding messages regardless of spelling errors and even perceiving users' emotions. According to [11], chatbots based on AI "can use several methods, algorithms, techniques, and integrations that make software "intelligent". Services are increasingly using automated tools to serve the consumer or the citizen. The use of chatbots is growing rapidly. Applications such as training, health care or general consumer questions are common. [12] warns of aspects related to interaction with robots that will make the need for greater attention to the subject, such as the risk of dehumanization of care, loss of rapport, even though the written text may generate the feeling of being attended to by a human and the interaction style is said to influence the impact of chatbots on user's intention [2]. Chatbots can be programmed to promote empathy and, in some stances, they can be indistinguishable from a human. Eventually, at the societal level, they may lead to a potential loss of jobs.

[13] pointed out that chatbots can be mechanical, analytical, intuitive and empathic. A chatbot acts on the first level, based on automatic responses created a priori in a script, although the second level can generate adaptations based on data, which allow, or example, adopting alternative scripts depending on the analysis of the episodes with the highest incidence.

C. Chatbots in the relationship with the citizen and the consumer

Chatbots' use is increasing worldwide, in a plenty of services activities including public relations, medical and defense [14]. Among publics agencies, NGOs and governments, the use includes health assistance, counselling, customer and citizen care, normally as an application hosted in a website and part of a wider campaign, turning responses to citizen faster and more coherent [15]. In general, chatbots can help solving the most common questions, providing standardized responses, whilst personal attendance can focus on more elaborated and non-programmable questions. Also, it is possible to cite governmental agencies that already use it as an e-government tool both a) permanently, such as the Federal General Controlling of Ministry of Finance, in Brazil, and b) in a temporary basis, such as the Brazilian Ministry of Education (for National College proficiency exams' questions) or the Oncology Portuguese Society (the 'I have cancer. And now?' campaign), in Portugal [16]. See some chatbots in use on governmental agencies on table 1.

TABLE 1 – SOME CHATBOTS IN GOVERNMENTAL AGENCIES

Name	Agency/ Country	Channel	Function	Platform	Target audience
Poupinha	Poupatempo/Data Processing Agency/São Paulo State, Brazil	Facebook messenger and official website	Online services		Citizen
Quito Guide Bot	Ministry of Tourism, Ecuador	Facebook messenger	Atractions, history, statistics	Ecuabots	Tourists
Victoria	Digital Public Innovation Agency / México	Facebook messenger, Twitter and text messages	City services, payments, schedules, complaints and events		Citizen and tourists
Luci	Prosecutor's Office- Acre State/Brazil	Official website	Intranet	Dialogflow	Employees
Bot	Innovation and Digital Transformation Agency - Buenos Aires Municipality / Argentina	WhatsApp	City services and events	Botmaker	Citizens and tourists
CROMG	Regional Dental Society – Minas Gerais / Brazil	Facebook Messenger	Requests, complaints,		Dentists

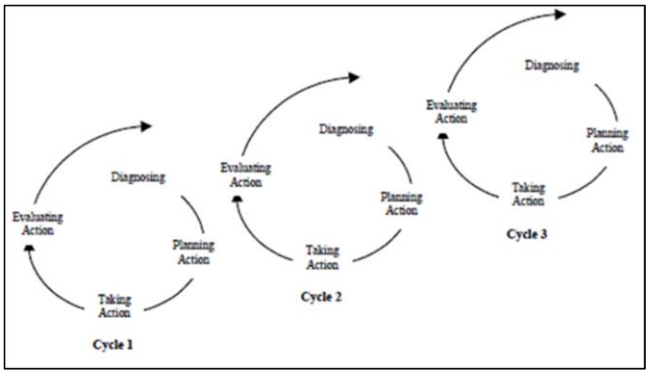
III. METHODOLOGICAL PROCEDURES

Data was collected according to the action research methodology, in order to understand how available information could be enhanced and decision-making process improved concerning the development of the chatbot.

A. Characterization of the type of research

The problem at hands comprised the intention to smooth the process of caring the clients' needs, several interactions on basics questions, and lack of human resources. Based on a qualitative and interpretative method - action research [17] [18] [19] [20], one problem was analysed. [21] defined action research as a democratic and participative process, focused on the Development of practical knowledge in the search for human purposes useful and grounded in a participative approach to the solutions. According to the authors, the collaboration between action and reflection, theory and practice, in a participative process, is crucial in the search of practical solutions for problem[18] which includes a pre-step, that demands knowing the context, and understanding the project's goals, along with 4 steps: diagnosis, planning, action and action's assessment.

FIGURE 1 – ACTION RESEARCH CYCLE



Therefore, after the analysis, an intervention was proposed, through the creation of a chatbot prototype. This spent a 6-month period, in 2019, of data collection by direct observation, discussion and intervention, as part of an internship program, with a supervision of a senior tutor.

B. *Development steps*

We adopt for the above purpose a prototype with the following steps:

a) Evaluation of the current service situation of the sector of the organization that will receive the application, and verification of how the service works;

b) Identification, according to the previous evaluation, of which are the most relevant and common questions posed;

c) Definition of what will be the total possible responses from which the chatbot will chose the response to provide to citizens' questions;

d) Development of the chatbot knowledge base;

e) Development of the flow of conversation.

C. *Plant Health department current workflow*

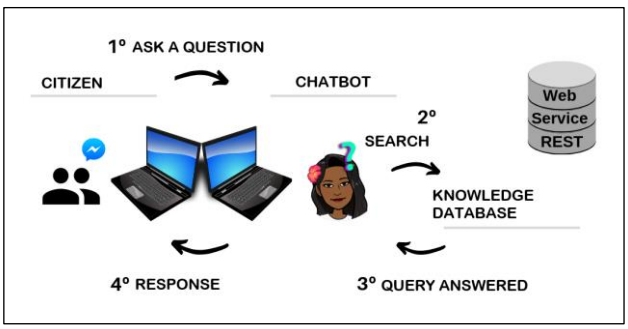
Based on what was done, users with questions to be addressed to MAPA can check its official website located on the Government's website. They can also call the direct phone, send an e-mail to the department, or attend in the locations available, at office hours from 2:00 pm to 5:00 pm.

To improve the flow of activities, a possible solution was to implement a real-time. Therefore,,the software should prepared to help with the institution's duties, respond the most FAQs of citizens, and this way release inspectors for more complex activities.

IV. PROPOSED SOLUTION

It is within the context illustrated above that it was considered the possibility of development of a conversational robot or chatbot. It was decided to call it Flora (whose title is an analogy to the definition of the word “set of plant species in a region or ecosystem”). The first step for the development of the prototype consisted of the creation of a visual platform in which the messages between the robot and the citizen/user were going to be exchanged. The second step included the processing of these messages. The final step comprised the storage and return data from the knowledge base generating the response.

FIGURE 2 – DATA ARCHITECTURE

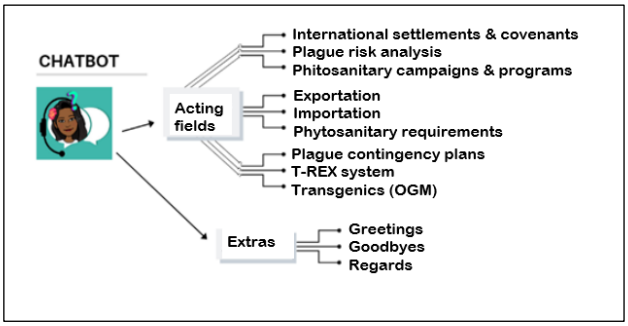


The figure above represents the platform architecture. The user enters the Facebook Messenger chat and asks the robot the question, which in turn searches for the answer in the database registered in the Web Service Rest. Subsequently, there is the return of the information requested by the chatbot.

A. *Scope of Chatbot Knowledge*

The areas of knowledge were divided into two categories: acting fields and extra activities. Figure 3 shows a mind map defining each category.

FIGURE 3– MENTAL MAP



In the category acting fields, we have information directly on the attributions of the Plant Health department, such as import and export procedures, phytosanitary certificates, international standards and requirements, and accreditation. This information was taken from telephone calls and e-mails received by the sector's servers. The additional category – Extras - was created so that the robot has a more human and receptive language.

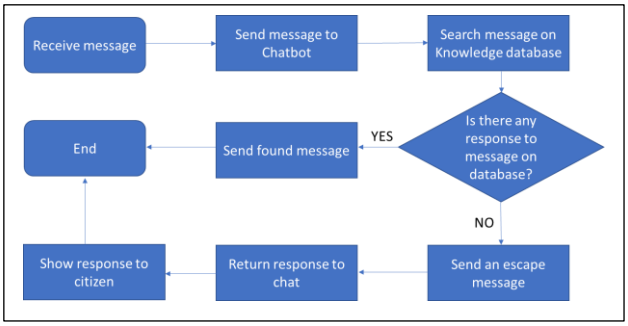
B. *Platform definition*

Currently, there are some platforms with more understandable and less complex programming languages in which it is possible to base the chatbot. However, for the purpose at hands, we understood that Facebook Messenger was a good alternative. Among its advantages, the following stand out:

- Easy access platform, since many users already have the application installed on their mobile devices, and the only action that the citizen should take is to search the name in the bot in the main search field of Messenger;
- It is possible to create and make connections, being able to have conversations with people simultaneously, offering a personalized experience for the public [1];
- This application has no cost.

As we can see in the flowchart below, it all starts with the user's question. The second step is the search in the knowledge database using the AI algorithms on the subject asked. The figure below shows the processing of a message received through the flowchart.

FIGURE 4– FLOWCHART



ManyChat was used to apply AI, a platform created around 2015, easy to build and integrate with the Facebook Messenger Platform. This allows to self-tune the chatbot creation process. In addition, it is possible to draw the flow between conversations using graphic resources.

Besides, it is possible to know the user's intentions through word classification: a certain set of words inserted will serve as a sample, so that the AI algorithms give the best response according to the messages received.

C. Tool Interface

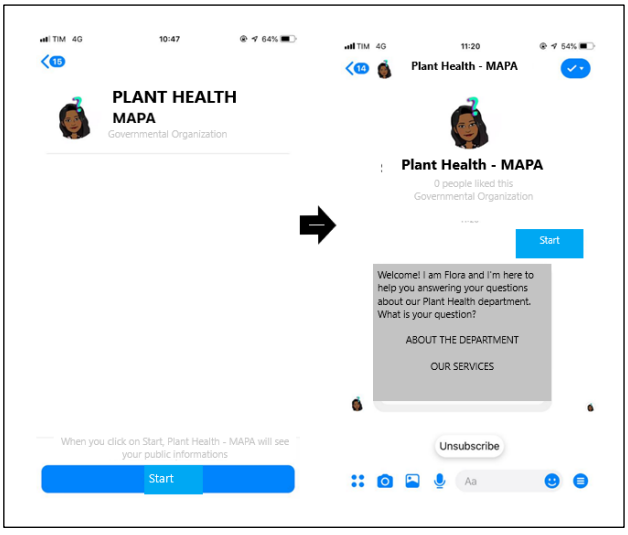
Interface visualized by the user when contacting the chatbot is shown in figure 4, where there are three main blocks:

a) Header: contains the name of the robot and the close button;

b) Body: interactions (messages) exchanged between the citizen and the bot. In the figure above we can see that the message was returned (see Fig. 5);

c) Keyboard: with the functionalities of the Messenger application.

FIGURE 5 – CHATBOT'S HOMESCREEN



V. FINAL THOUGHTS

In this the investigation, it was possible to see that AI does not bring in advantages just for the companies but can also be used at e-government level for the good of the citizens and of a society at large, as there seems to be a better allocate resources. Citizens that could have difficulties in obtaining the required information via other methods, may also feel more confident in asking their questions through the bot. In this project we were able to create, modify and come up with a proposal for the development of an agile and modern platform to improve the flow of activities, to optimize the service to the citizen of a Brazilian governmental department. Also, it was possible to study the various tools for building the prototype, which better turn agile the process.

In fact, the Chat Flora tool has the potential to transform communication between citizens and the government, switching it from person to person to human to person. This can be made through the use of social networks, as a communication channel that is now intuitive for most citizens. Most individuals are aware of the mechanism of conversation and used to exchange messages, which means that an educational initial need is overcome. This turns the process of implementing a chat bot strategy smoother. Through a quick, simple and effective dialogue, the chatbot offers yet another path to digital citizenship. While providing the information, it receives feedback in real-time. Simultaneously, it allows individuals to feel like they are part of the updated world in which communicating, either with other or with machines, became a simple and widely accepted operation. The Marketing Information System has, therefore, a lot to gain with the implementation of Flora.

Additionally, a chatbot like Flora can promote communication exchange and allows spreading information. This includes good practices about plant health and agriculture. This way, this project can contribute to food security, helping to achieve UN SDG number 2 - zero hunger Therefore, we believe in the pros of the tool, as it is perceived as easy to use and very useful, providing the information required, and in real time. For this perceived usefulness to be evident, the process requires careful planning. And that is why a fine-tuned process needs to be put at place in order to anticipate all details that may be necessary to take into account in a communication of this type. Hence, there will always be space for improvements in the algorithms, as well as we recommend experts to try to understand which communication style is more appropriate and accommodate changes that may improve user's trust (De Cicco et al, 2020).In addition to the citizen obtaining knowledge and access to the public services available, he/she can also suggest improvements, indicating exactly where the public services are failing. In this way, corrections can be more assertive and impactful. Additionally, this channel provides 24/7 assistance (every day, anytime), reducing the workload dedicated to e-mail and telephone responses that the agencies will need to have.

However, for all of these advantages to be successful, the user's experience must be positive. In other words, the dialogue between the machine and the human must be well structured, the feedback must be immediate, the information from the services must be complete and, above all: the platform's functionality must be simple and self-explanatory [21].

Therefore, it is essential to understand that, in this first moment, the chatbot demands the massive participation of

citizens, civil servants, and public managers so that, from each interaction, it is possible to progressively improve and understand the user's needs [21].

Among limitations of this tool, lack of integration with other applications or absence of a voice-based solution, a voicebot, can be listed. Also, data integration with a CRM system is an important challenge [22]. Needless to say that users with low digital literacy can also reveal difficulties in interacting with the chatbot via messenger; and users with no Messenger account cannot either use Flora. Not having had the possibility to test this is also a limitation of the study, which, because it was conducted in an exploratory way, limits the possibility of replication of the results. Also, the sample is too narrow, which also inhibits the extension of the cons to other contexts, namely to other governmental departments and contexts.

We may also present as suggestions for managers: the effort to continuously expand the bot's knowledge base; expand it to other platforms besides Messenger; the creation of a solid database integrated with the other sectors; and, finally, an increase of service channels. All of these advises within a continuous concern in providing a good customer experience, throughout all the available channels.

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