Maintenance Assisted by Artificial Intelligence (MAAI)

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ABSTRACT

This work presents the realization of a maintenance device assisted by artificial intelligence. This system makes it possible to improve the supervision of the network, the analysis of technical feedback, and the correlation of those feedbacks to reduce incident resolution times and better plan or initiate interventions. More precisely, our system is built up based on the ZABBIX package for monitoring, the Alexa package for the conversational agents as well as on some Artificial Intelligence bricks such as AVS, IoT, AWS... It is added to the list of possible solutions and acceleration levers for operators 'growth by reducing the time to detect faults in the network.

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Classification: DDC Code: 006.3, LCC Code: Q335

Language: English

London Journals Press

LJP Copyright ID: 975812
Print ISSN: 2514-863X
Online ISSN: 2514-8648

London Journal of Research in Computer Science and Technology

Volume 22 | Issue 1 | Compilation 1.0

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This work presents the realization of a maintenance device assisted by artificial intelligence. This system makes it possible to improve the supervision of the network, the analysis of technical feedback, and the correlation of those feedbacks to reduce incident resolution times and better plan or initiate interventions. More precisely, our system is built up based on the ZABBIX package for monitoring, the Alexa package for the conversational agents as well as on some Artificial Intelligence bricks such as AVS, IoT, AWS... It is added to the list of possible solutions and acceleration levers for operators 'growth by reducing the time to detect faults in the network.

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I. INTRODUCTION

The infrastructures of telecommunications operators include an increasing number of equipment of the most varied in terms of voice, data, video services, etc. Declined by business line, these are telematics systems that rely on IT resources, the scope of which is constantly expanding, with the interconnection of intranets, the internet, distributed and heterogeneous systems (telephony, Wifi/3G/4G network, base stations, switches, etc.) and ever newer technologies. The proper functioning of such systems requires many human resources to ensure their maintenance, which is generally computer-assisted. Artificial intelligence devices such as conversational agents, also called chatbots, aim to improve the computer-assisted maintenance system, less wasted time, autonomy, continuity of service, and better efficiency. Monitoring is essential for the proper conduct of maintenance activities. It is the process of ensuring the availability and performance of the equipment of a telematics system at all times. Nowadays, there are several monitoring solutions, like ZABBIX, the availability and performance of the equipment of a telematics system. There are also several monitoring solutions, like ZABBIX [1], CENTREON, NAGIOS, PRTG (Paessler Router Traffic Grapher), and others, making it possible to optimize the functioning of infrastructures at all levels (integrity, performance, availability, etc.). Our work contributes to the maintenance assisted by artificial intelligence, which combines the use of conversational agents and the judicious choice of monitoring tools to equip itself with a real maintenance assistant driven by artificial intelligence and allowing to increase productivity, improve the employee experience and help engineers and technicians in the field.

II. GENERAL INFORMATION ON ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is defined as a set of theories and techniques implemented to produce machines capable of simulating human intelligence, therefore, it corresponds to a group of concepts and technologies more than to a constituted autonomous discipline.

A chatbot can work well without artificial intelligence and natural language recognition. It is the case of all the bots that offer conversations that only include closed or multiple-choice questions. However, to simulate a human conversation and amplify the performance of chatbots, it is necessary to equip them with artificial intelligence. AI is therefore an additional

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component of the chatbot. By integrating AI into our chatbot, we will be able to manage things like:

- The context
- Mimicry. The data and the exchanges with humans will allow the chatbot to acquire automatisms and train itself to have as natural a conversation as possible about maintenance tasks.
- Automatic speech recognition. Automatic speech recognition (often referred to as voice recognition) is the computer technology that will allow the assistant to analyze the human voice picked up by using a microphone and transcribe it into text before proceeding.
- Speech synthesis. It is the computer technology that will allow our system to create artificial speech from a typed text.

III. ARTIFICIAL INTELLIGENCE MODEL

Artificial intelligence simulates the human intelligence, which is based on the brain. Companies like Microsoft, Apple, Google, AMAZON, and others have made artificial intelligence solutions based on artificial neural networks. These are integrated into chatbots known on the market as Cortana, Siri, Google Now, and Alexa.

These AI solutions are Cognitive Multi-Agent Systems in which one agent translates the voice request into text, and another understands and interprets the message resulting from this translation. An agent uses the keywords recognized in the interlocutor's intentions to search for information in Wikipedia according to the business logic, which can be weather, location, and in our case maintenance tasks. Once the information is found, the reverse operation is performed until the response is translated from text format to voice format.

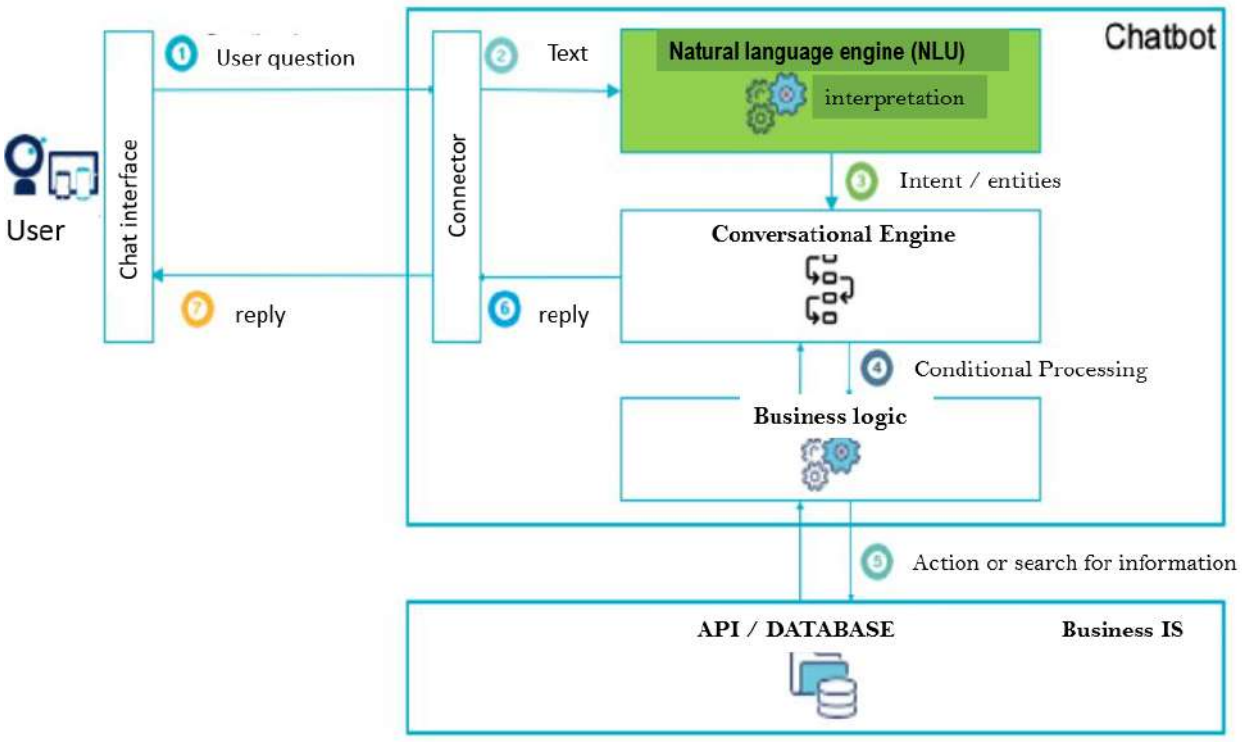

Figure 1: The operating principle of a multi-cognitive agent system [2]

Cortana, Siri, Google Now, and Alexa are all Level 3 chatbots because they use intent detection as a natural language understanding technique. They understand simple sentences with error tolerance, and their voice responses are contextual. However, our interest was focused on Alexa, because we can embed it in a connected speaker like the Raspberry Pi [3]. It is a generalist multi-agent cognitive system that we can specialize in a specific domain by adding skills.

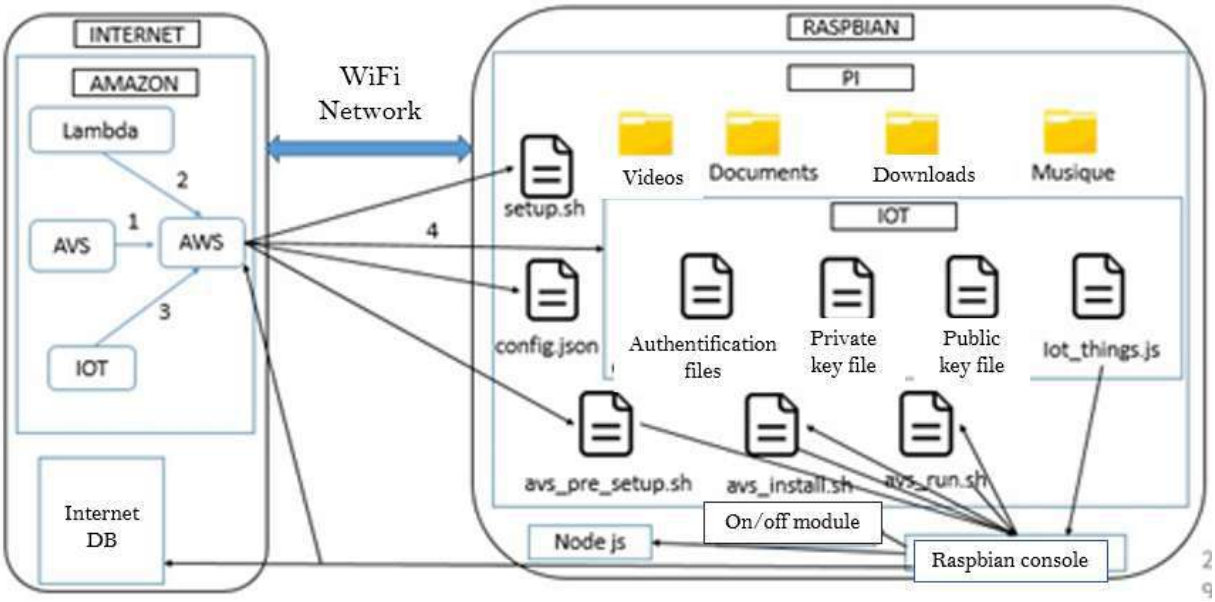

Figure 2: Integration of Alexa in the Raspberry Pi

IV. MONITORING TOOLS

There are many monitoring software on the market. Still, for the realization of our maintenance task tool, we have chosen ZABBIX as the solution to embed in the Raspberry Pi because it is compatible with many platforms, it has a large community, it is open-source, it has a lot of features (generate network maps, make graphics, display problems on the network and notify engineers in case of failure, etc.) and it uses data encryption.

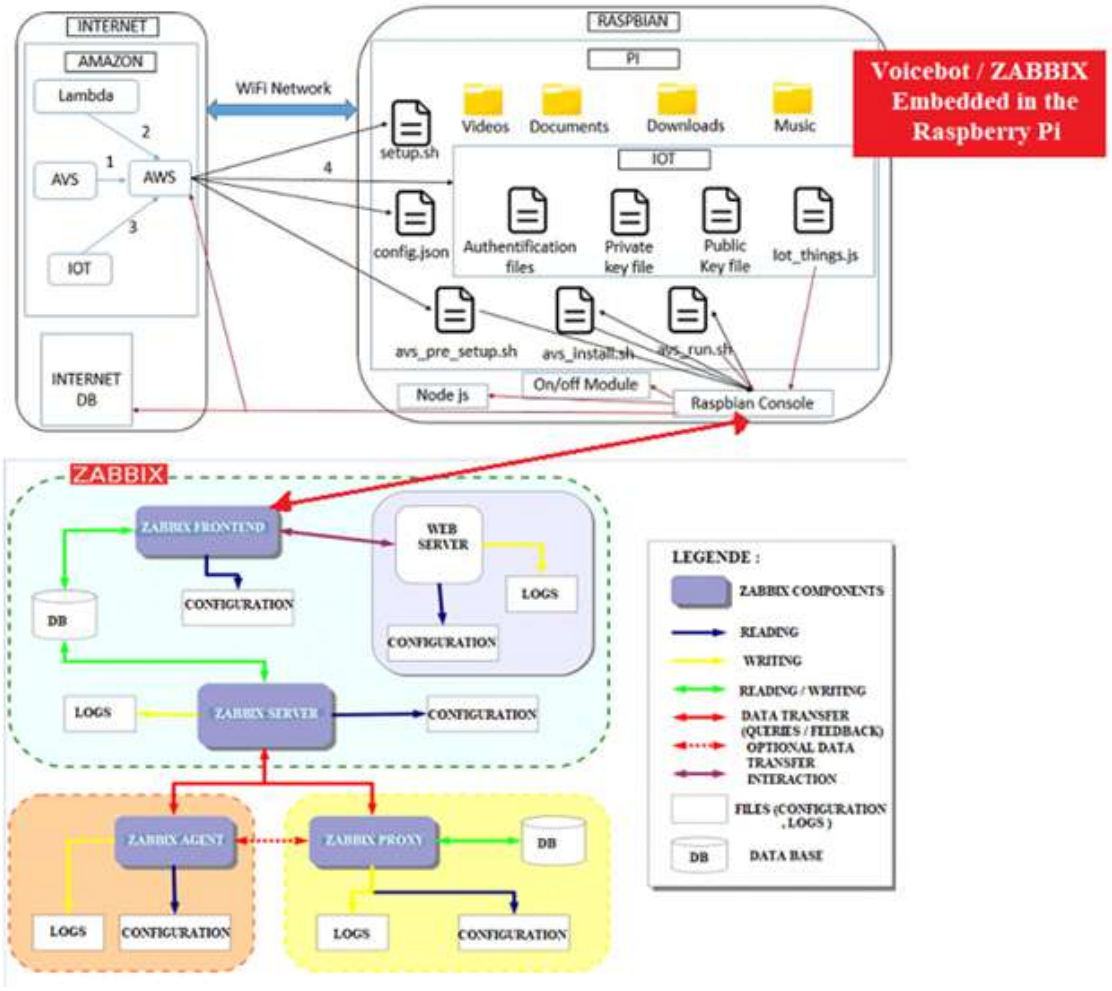

Figure 3: Integration of Zabbix in the Raspberry Pi

V. MODELING OF THE ASSISTANT

The device we call MAAI (Maintenance Assisted by Artificial Intelligence) allows us to obtain real-time information on the state of network equipment, automatically alert engineers and technicians in the event of a problem and even prevent possible network failures, and remedy them. These functionalities are performed thanks to the combination of ZABBIX' relevance, and the innovative nature of voice chatbots.

5.1 MAAI Artificial Intelligence Bricks

The three components of Alexa's artificial brain that we are going to embed in the Raspberry Pi to achieve our AI model are:

- *AVS (Alexa Voice Service):* it brings the intelligence of speech recognition, and synthesis.
- *IoT (Internet of Things):* it brings the intelligence to transform the Raspberry Pi into a connected object that can detect voice interactions, and bring out the responses audibly. It is also this module that ensures the security of the transmission of information.
- AWS (Amazon Web Services) allows us, thanks to its Lambda function module, to add skills to this artificial brain so that it can obtain information on the operating state of the operator's network equipment.

5.2 Wizard sequence diagram

Figure 4 describes the interactions between the different elements of our system

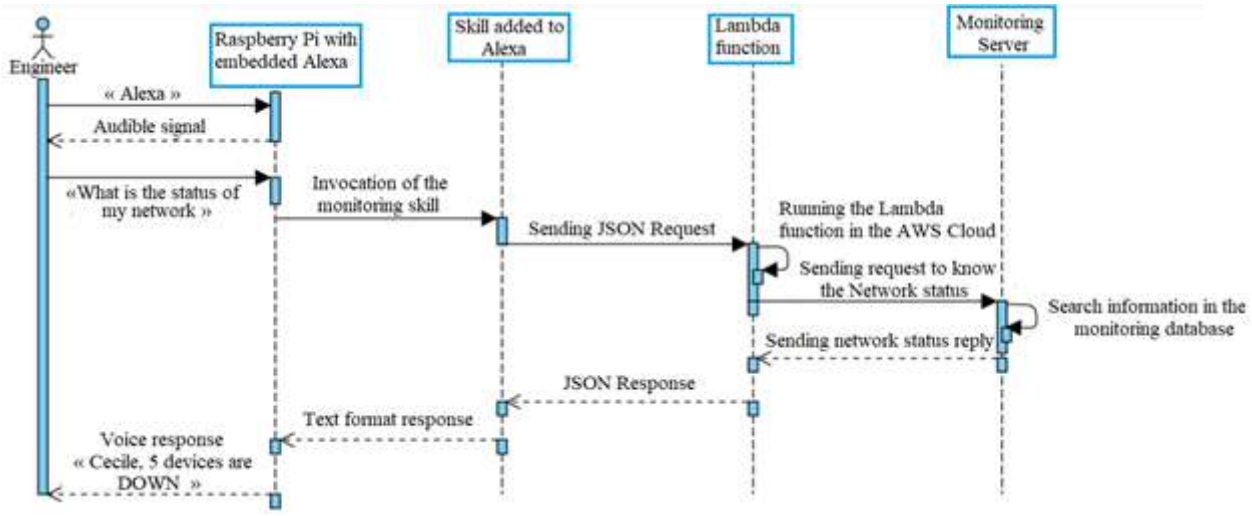

Figure 4: Wizard Sequence Diagram

5.3 MAAI architecture

The environment used for the realization of the MAAI prototype is composed of:

- A PC that allowed us to develop our monitoring skills thanks to the AWS Lambda tools (to write and host the function in Node.JS 12).
- 7-inch LCD touch screen connected to the Raspberry Pi 4B and in which we have embedded the Debian operating system, the Zabbix 5.0 monitoring solution, the components of the brain of Alexa, in particular, AVS and Telegram on the command line as well as Python 3 for the automation of alert feedback.
- Our two devices communicate by Internet and monitor the operator's network via the latter's intranet.

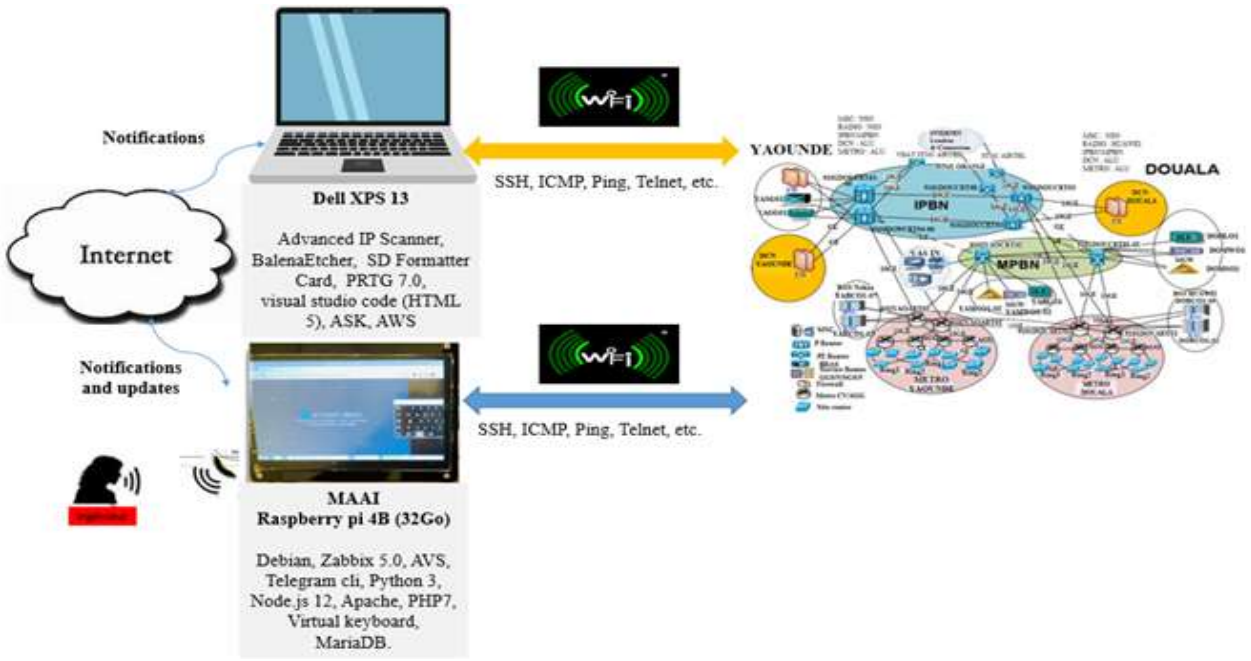

Figure 5: MAAI physical architecture: Case of the NeXttel operator [4]

5.4 Wizard implementation flowchart

The approach adopted to realize our solution is as follows in figure 6

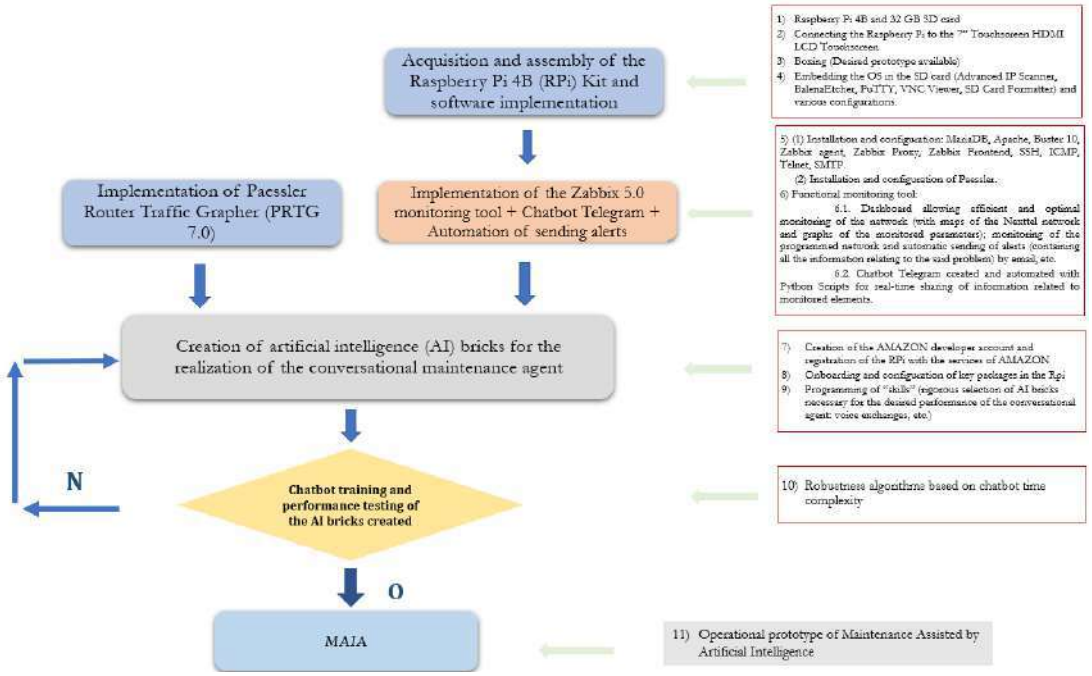

Figure 6: Realization steps

VI. PROTOTYPE

The operational prototype of Maintenance tasks Assisted by Artificial Intelligence (MAAI) has three main functions:

1. Vocal monitoring assistant with whom we can exchange information in real-time on the state of the network, and automatically alerts us by email and via a Telegram message in the event of a problem with a piece of equipment.
2. Tablet because we have embedded a virtual keyboard
3. Nano computer has all the capabilities and functions of a personal computer.

Figure 4: MAAI prototype

VII. CONCLUSION

Our MAAI solution, which uses advances in speech recognition and synthesis, will increase productivity by allowing engineers to save the time spent typing certain commands manually to obtain network status and by rendering information accessible everywhere.

REFERENCES

1. Cécile Lidwine I. NLEMBA. Design and production of a chatbot for artificial intelligence-assisted maintenance of the nexttel network. Master's memory, Ecole Nationale Supérieure Polytechnique de Yaoundé, 2021.

2. Olivier EZRATTY. *The uses of artificial intelligence*. ISSN 2680 - 0527, 2019.
3. John Paul Mueller, Mining Amazon Web Services: building applications with the Amazon API, Sybex, 2004.
4. Emmanuel TONYE, Alphonse BINELE. *Signaling in mobile telecommunications networks: Architecture, protocols and services*. AMAZON, 2018.
5. Nathan Liefting, Brian van Baekel, Zabbix 5 IT Infrastructure Monitoring Cookbook: Explore the new features of Zabbix 5 for designing, building, and maintaining your Zabbix setup [1ed.], Packt Publishing, 2021.
6. Amit Konar, Artificial intelligence and soft computing: behavioral and cognitive modeling of the human brain [1ed.], CRC Press, 2000.
7. Francesca Rossi, Peter van Beek and Toby Walsh (Eds.), Handbook of Constraint Programming [1st ed], Elsevier, 2006