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Knowai

Executive summary

The need of saving and sharing knowledge is a hot topic from the start of mankind and internet has represented a breakthrough for its spread and relevance. It started as a simple tool to enable people to save and share information they considered valuable and now it is common to search online for retrieving information about any topic of interest. The need to save information in a structured and easily accessible way is present in any human context, from the personal environment (e.g. find a recipe) to the industrial context. Nowadays companies are still facing some issues in managing knowledge.

The Knowai project was born from the cooperation of Alta Scuola Politecnica (ASP) with School of Entrepreneurship and Innovation (SEI): the purpose of the experience is the creation of a deep tech startup. After an initial period made of interviews, analysis and research, the team has decided to develop a system for **industrial knowledge management**.

The main goal of Knowai project was to develop an innovative solution based on the use of Artificial Intelligence techniques that deals with the complex but challenging problems of knowledge digitalization and management in the industrial context. For this purpose, the developed MVP is configured as a hybrid solution between a Chatbot and a Knowledge Management System (KMS) and it has been realized for an application in assistance processes.

Key Words

Knowledge Management, Customers' Assistance Process, Natural Language Processing (NLP).
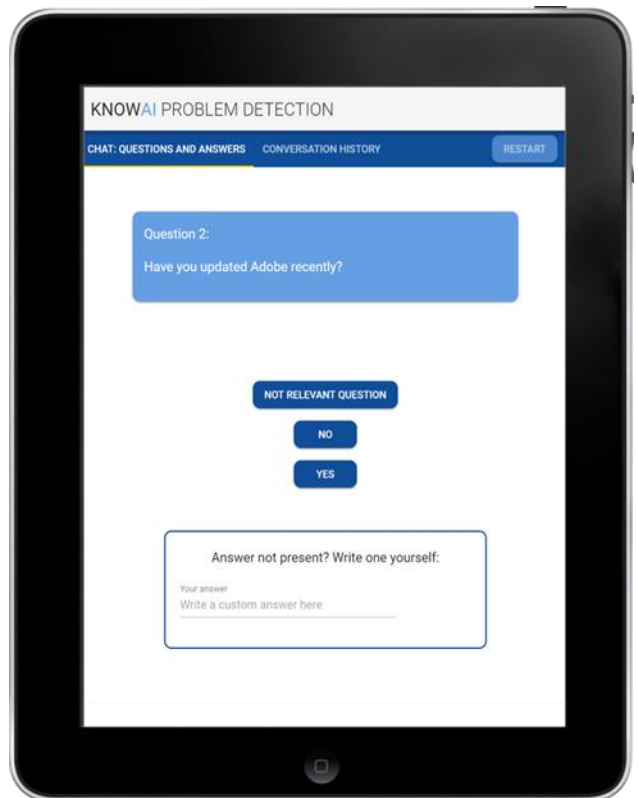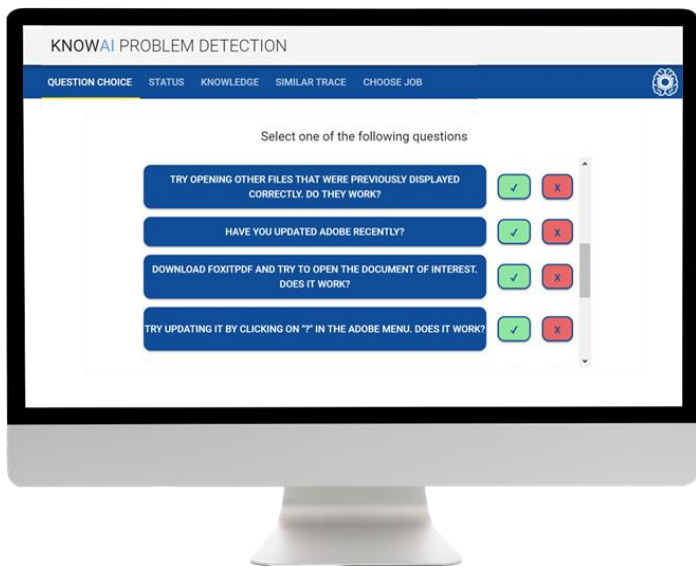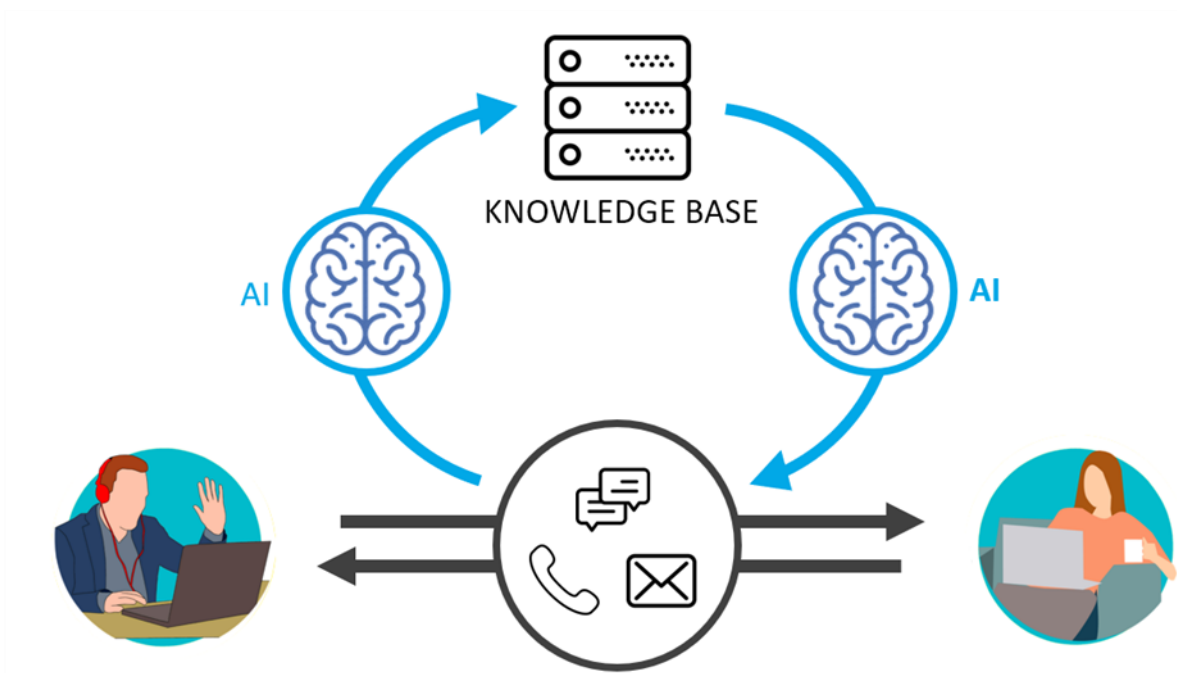
Knowai

Figure 1: Graphic representation of the working principles of the solution developed by the Knowai team.
The software aims to facilitate the identification and resolution of problems between the selling company and the customer company using the knowledge extracted from the past communication flows.
Two software interfaces are shown here: the tab used by the expert (left) for having a conversation with the operator that reported the symptom and the tab used by the operator himself (right) for answering to the questions.
The added value of the Knowai system is given by the fact that knowledge displayed in the interfaces is extracted from previous exchanges of information.

Project description written by the Principal Academic Tutor

Artificial Intelligence (AI) history started more than 50 years ago, but it has shown to the world its real capabilities only in last two decades.

New applications are growing in any conceivable field and products based on image recognition or recommender systems have now reached several markets. Despite the fast diffusion of AI, there are still some sectors where few real solution are present, and one of this is the industrial knowledge management. Industry 4.0 revolution led all businesses to the production of tons of data regarding their processes but for the moment companies are focusing more in data collection rather than in data exploration. The latest AI developments enabled new tools that can disrupt the way we manage data and the kind of data we can manage. Natural Language Processing (NLP) progresses indeed open unexpected opportunity for processing "human generated data", like documents and conversations, offering the chance to capture meaning behind words and so increase the possibility of comprehension.

Knowai team worked to find a touching point between opportunities given by the usage of new technologies and market needs. Focusing on industrial processes, they analysed the way in which companies are attempting to manage their knowledge, trying to identify hidden criticalities. According to the results collected during the research phase, they attempted to develop a solution for the management of knowledge in the assistance process, which seemed to be the suitable entry point for approaching the issue. After a first phase focused on the product definition, the team faced the implementation challenge, developing a working Minimum Viable Product (MVP) and testing it in a real case scenario. Together with first technical results, the team managed also a product validation phase, aimed at understanding whether the developed solution could reach the market fit. This whole work helped them to identify which are the challenges hidden behind the development of a real deep tech product based on AI.

Team description by skill

The team is composed by seven engineering students, coming from the Politecnico di Milano (PoliMI) and Politecnico di Torino (PoliTO):

Federico Betti, Computer Science and Engineering, *PoliMI*, Techno-economic Assessment, Application Development, Machine Learning Engineer.

Marco Centurioni, Automation and Control Engineering, *PoliMI*, Strategy, Business Analysis, Business Model Development, Project Management.

Alessio Colucci, Electronic Engineering, *PoliTO*, Application Development, Backend Development, Software Deployment.

Domenico Ruben Pangallo, Biomedical Engineering, Team Controller, *PoliTO*, Economic Assessment, Competitor and Stakeholder Analysis, Market Analysis.

Nicola Pivaro, Automation and Control Engineering, *PoliMI*, Strategy, Business Analysis, Business Model Development, Project Management.

Alessandro Rosiello, Space Engineering, *PoliMI*, Competitor and Stakeholder Analysis, Market Analysis.

Ivan Vrsajkov, Computer Science and Engineering, *PoliMI*, Application Development, Frontend Development (User Interface).

Goal (Main Issues, Proposed Solution, Advantages)

The objective of Knowai project was to develop an innovative solution based on the use of AI techniques that deals with the problem of knowledge digitalization and management in the industrial context.

The result of the market analysis and the study of the solutions actually present have been compared with the needs and requirements of companies (especially Italian SMEs). What emerged is the technological incapacity of the current solutions (KMSs, Chatbots, Ticketing software) to fully guarantee some fundamental features requested by the employees and consequently by the companies themselves. In particular, the industrial technical assistance appears to be one of the most mature application context for the introduction of tools for the management and sharing of knowledge. Therefore, Knowai team has decided to develop a technological solution designed specifically to manage this process.

The aim of the product is to provide a platform that customers can use as a messaging service from which to extract information, save knowledge in a Knowledge Base (KB) and make everything available later on. In this regard, it is therefore configured as a hybrid solution between a chatbot and a KMS applied in the field of technical assistance and is characterized by the adoption of modern techniques of NLP and AI for saving hidden knowledge in a semi-structured information flow. In particular, the Knowai system aims to read, learn and broaden the knowledge base processing past communication flows (i.e. assistance requests). In this way, the trained KB can be used to provide advices to the expert who delivers assistance on the procedure for identifying and resolving the problem encountered by the operator of the customer company.
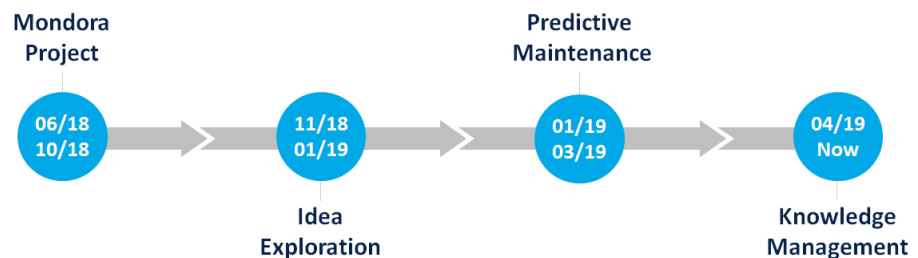

Figure 2: Knowai Team path from the launching of the Pioneer Programme

Understanding the problem

The subject of knowledge management has always been a topic of interest, since good efficiency of any process is strongly dependent on the saving, sorting and accessing of useful information. For example, the last few years saw the birth of the concept of Industry 4.0. According to its basic principles, the future development of companies will depend mainly on the collection, management and analysis of data. Data are substantially numeric information, whose collection and processing generate well-known economic advantages. It is interesting to note that the data themselves are not profitable: value comes when people are able to take more aware actions in the light of the carried out analyses. The economic driver is not data, but rather knowledge that derives from it: successful companies are knowledge-driven and not simply data-driven. The last ten years opened a new historical period in which the theme of knowledge management has reached a new hype thanks to the great amount of

data that has been saved and thanks to the new technologies that have been developed. In the following points, an analysis about elements involved in the rise of need and interest for knowledge management is shown.

The last 40 years of history have been mainly characterized by two factors for what concern industrial development: *technology growth inside companies* and *Increment of technology growth rate*.

The first factor is related to the need of keeping competitive advantages which forced companies to study and develop new solutions, especially for what concern technical tools. One of the direct consequences of the tech growth is the increase of knowledge that companies have to manage to produce their specific products or services. It is evident that one of the needs is knowledge accessibility. This kind of issue is becoming more and more relevant in several industrial situations where the amount of knowledge involved in the processes is increasing month after month.

The second factor is related to the fact that technology growth rate is increasing year after year: on the one side this brings direct advantages enabling new opportunities, but on the other side this peculiar transformation is showing to the world new scenarios where technology growth is so fast that people are struggling to keep pace. One of the most significant examples of this transformation is related to the automation processes.

Exploring the opportunities

After acquiring a complete vision of the problem of knowledge management, both from the technical and the business sides, the team started exploring different possible solutions: the first ideas that came out were related to state-of-the-art, like chatbots, digital manuals, ticketing systems and knowledge management systems. However, each of these current solutions is extremely focused only on a certain aspect.

Chatbots are very good for interaction when the involved knowledge is limited, like in the case of a customer service application.

Regarding digital manuals, instead, they are very useful because there is a lot of knowledge inside, but most of it is unstructured in terms of problem-solution occurrence, while being structured in terms of content. Consequently, it is very difficult to use in real life scenarios when a new problem shows up, requiring a different solution.

Ticketing systems are widely used for support since they provide an easy way to categorize interactions: however, they do not extract knowledge from them, so they partially solve the problem of knowledge management.

Finally, knowledge management systems (KMSs) are the most useful in managing knowledge, but their problem is they are not feasible for interaction with customers, thus knowledge has to be entered manually by experts. This process hinders the creation of a vast knowledge database, actually slowing down the whole process of knowledge management. An example in this direction is given by Maana, which aims to build a KMS and is currently gaining traction, thanks also to its being backed by powerhouses (e.g. Microsoft) that provide integration with their own management framework. Nonetheless it is still lacking the interaction with the customers.

These are the different solutions which are currently used as state-of-the-art, but Knowai wants to put them all together to create a single system which is easily accessible but stores an enormous quantitative of structured knowledge,

obtained directly from the interactions between customers and operators, and enriched through other available data such as the one from sensors.

Generating a solution

As previously stated, the Knowai team decided to focus on the field of technical customer assistance. The information exchange between the operator, who is reporting an issue, and the expert, who is trying to find the root cause of it and fix it, contains unstructured knowledge that constitutes the expert's know-how. Therefore, the proposed solution is a product that is able to extract unstructured and hidden knowledge from a semi-structured information flow and utilize it in future uses.

The conversation between the operator and the expert can be modelled as a process that begins with the **symptom** reported by the operator and continues with a sequence of **questions and answers** between the two subjects. In particular, the symptom is the way the problem is being manifested to the operator. The questions are then asked by the expert. The point of the conversation is to identify the actual problem and suggest a way to fix it.

The main features of the product are the recommendation of the best suited questions and the prediction of the most likely problem based on the conversation up to that point. The algorithm tries to find the best possible sequence according to the probabilities assigned on the basis of previously encountered conversations, which represents the **knowledge** the product has collected so far.

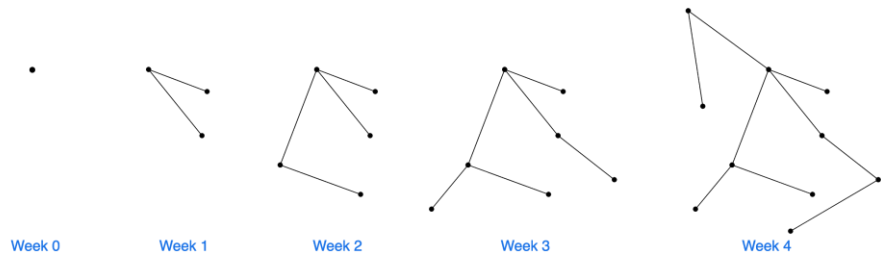Week 0   Week 1   Week 2   Week 3   Week 4

Figure 3: Growing of the Knowledge Base (KB) with the usage of the system.

However, there are far too many possible questions an expert could ask the operator: the knowledge gathered can be too broad. This is why the symptom analysis by using NLP techniques is done in the beginning, to find the best entry point in the knowledge that will most likely lead to a correct prediction. Throughout the whole process, the experts can provide feedback to questions and state the correct outcome at the end of the process. This will be used by the product to learn and make better predictions in the future.
The system as a whole is deployed on a server in order to be able to collect the knowledge in one single centralized database. In this way, knowledge can be shared among all experts of the same company. The users of the proposed solution access it through client applications that interact with the server.
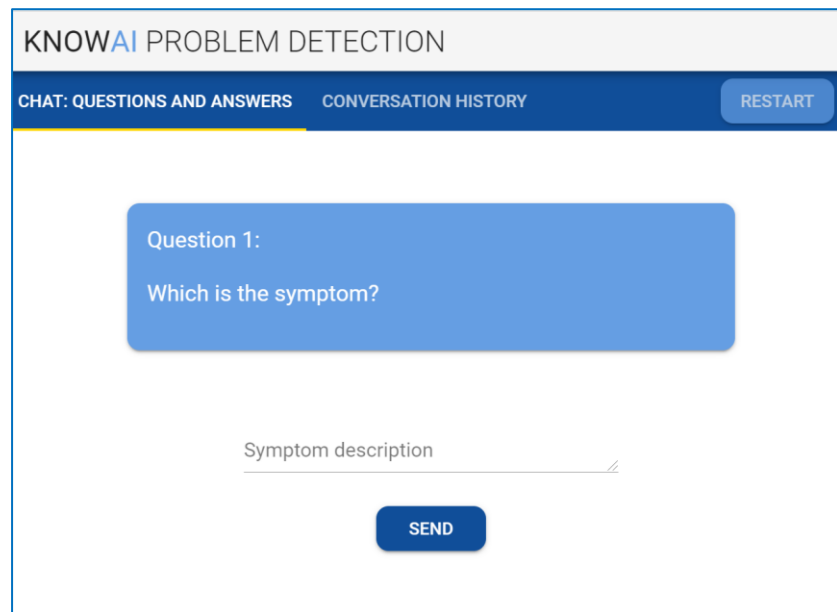
Figure 4: Operator Interface (used to report a new issue observed and to enter a discussion with an expert, who will in turn identify the cause of the issue).
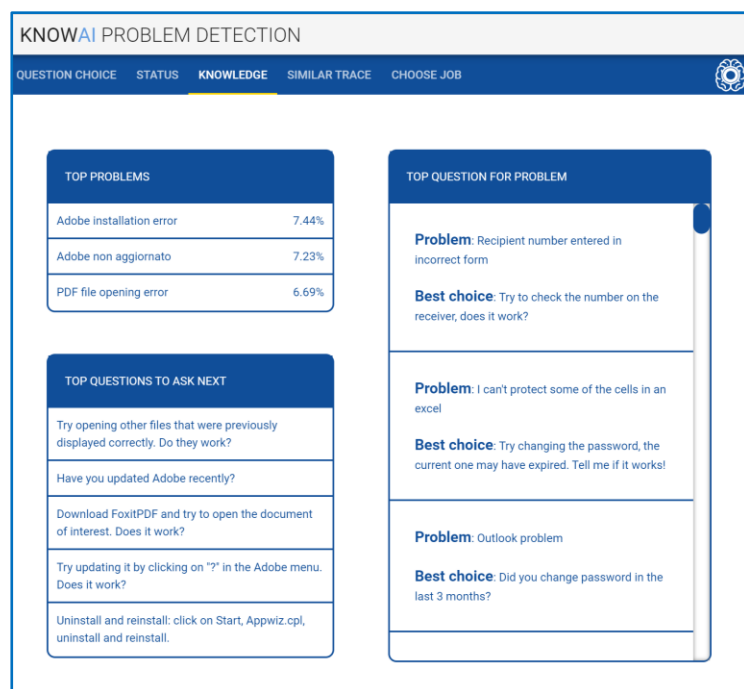

Figure 5: System Knowledge Base Interface. It provides a more in-depth description of the current point in the problem identification process regarding the currently selected job.

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