SCIENCE & CREATIVITY TO INVENT A SUSTAINABLE WORLD

PhD Position in
Computer Science
(AI & Software Engineering)

Institution	IMT Mines Alès (Ecole Nationale Supérieure des Mines d'Alès)
Main job assignment	Teaching and Research center in AI, industrial and digital engineering
Administrative residence	Alès (Département du Gard – Région Occitanie)
Starting date	01/10/2024

1. Context

The Institut Mines-Télécom (IMT), a major institution within the meaning of the Education Code, is a public scientific, cultural and professional institution (EPSCP) placed under the principal supervision of the ministers responsible for industry and digital technology. It is the largest group of engineering schools in France, with 11 public engineering schools spread across the country, which train 13,500 engineers and PhDs each year. The ITM employs 4,500 people and has an annual budget of €400M, 40% of which comes from its own resources. IMT has 2 Carnot institutes, 35 industrial chairs, produces 2100 A rank publications annually, 60 patents and carries out 110M€ of contractual research.

Created in 1843, IMT Mines Alès currently has 1,400 students (including 250 foreigners) and 380 staff. The school has 3 research and teaching centers of high scientific and technological level, which work in the fields of materials and civil engineering (C2MA), environment and risks (CREER), artificial intelligence and industrial and digital engineering (CERIS). It has 12 technological platforms and has 1,600 partner companies.

2. Research project

Title: TeleChatBot a Conversational Agent for Requirements Collect and Analysis to set up Specification Models

Keywords: Requirements Engineering, Artificial Intelligence, Natural Language Processing, Systems Modelling (UML, SysML).

Context.
It's a well-known fact that software systems development is very often more expensive than expected, development time is difficult to evaluate and, very often, the end result disappoints stakeholders. One of the reasons for this is to be found in the upstream system design phase, known as needs and requirements engineering, which consists of gathering the expectations of project stakeholders from functional and non-functional points of view (performance, security, safety, ease of use, etc.). The classic methods used for this stage are based on interviews, conducted by the project manager or a Requirements Engineering expert. They take the form of contractual documents in text format, which are difficult to verify and often ambiguous or incomplete. These discussions are therefore fundamental to building the future software system. In addition to interviews, rigorous approaches (goal tree, definition of prototypes, graphical interfaces, use cases, context formalization) lead to the elaboration of requirements models in the form of class or requirements diagrams [1], goal diagrams [2], or social models [3]. Unfortunately, software engineering companies often neglect Requirements Engineering (RE) stage, and don't take the necessary care with it.

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Issues

Collecting Requirements focuses on understanding the context of the project to be developed and its objectives. It is above all an exercise in expression and comprehension in natural language, combining know-how relating to the level of abstraction of the exercise, so as not to get lost in details that would be more appropriate to the realization stage than the design stage. This know-how is also linked to two areas of expertise: expertise in RE (requirements collect, verification and validation) and knowledge about the target domain.

In order to encapsulate the required expertise within a single entity, we wish to study the possibility of automating the collect of Needs & Requirements and their validation/verification by a conversational agent (chatbot)

Solution to be explored.

Recent advances in AI techniques such as classification and NLP, based on Large Language Models, demonstrate the interest of such techniques for requirements elicitation and analysis [4, 5]. Some work has been carried out on the improvement of requirements already formulated using user opinion classification techniques [6 - 8, 9], and conversational agents are beginning to emerge [10].

As the results are far from satisfactory [11], and the use of AI techniques poses responsibility problems [12], we propose to study how to combine NLP techniques with the capitalization of a know-how relating to the RE and to the application domain (via an ontology, for example). This solution therefore requires experimentation with TALN and modelling techniques, and consequently a good knowledge of both fields.

This work will be implemented and tested as part of the telehealth application design phase.

Objectives and expected results

Several deliverables are expected from this thesis work:
- an analytical and critical study of the state of the art in both Requirements Engineering and NLP.
- an original method for improving not only the quality of requirements repositories and specification models, but also the process for developing them.
- a software prototype allowing the implementation of the method
- a proof of concept on an embedded tele health
- publication of the work developed during the thesis an international conferences or international journals.

3. Main references

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Engineering of a Health Monitoring App by Analysing Similar Apps: A Vision Paper," Proc. IEEE Int. Conf. Requir. Eng., pp. 75–80, 2022.

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[10] Walid Maalej. "From RSSE to BotSE: Potentials and Challenges Revisited after 15 Years", *2023 IEEE/ACM 5th International Workshop on Bots in Software Engineering (BotSE)*, Melbourne, Australia, 2023, pp. 19-22.

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[12] W. Maalej, Y. D. Pham and L. Chazette, "Tailoring Requirements Engineering for Responsible AI," in *Computer*, vol. 56, no. 4, pp. 18-27, April 2023.

4. Team supervision and PhD registration

Research center: CERIS, IMT mines Ales, Ales, France.

PhD school : I2S, Univ. Montpellier.

Supervisor: Gerard Dray ; co-supervisors : Anne-Lise Courbis, Binbin Xu, Thomas Lambolais.

5. Candidate profile

Diploma: Master degree in Computer Science.

Technical skills:
- Major Knowledge on Software Development Engineering and System Design
- Knowledge and practice in Model Driven Engineering: Meta Modelling, System Modelling and Model Transformation,
- Basic Knowledge in Machine Learning,
- JAVA or Python programming,

Soft skills:
- Solid oral and written communication capacity in French or in English
- Curiosity and Adaptability capacities to deal with the application domain: understanding knowledge and reasoning of experts in the telehealth domain.

6. Contacts

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