Journal of Theoretical and Applied Information Technology
31st May 2023. Vol.101. No 10

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

ADVANCING UNIVERSITY LEARNING WITH EMOTIONAL INTELLIGENCE AND MODEL-DRIVEN ENGINEERING: DEVELOPMENT AND EVALUATION OF A TEST PLATFORM

OUZAYR RABHI[1], MOHAMMED ERRAMDANI[2] , Saida FILALI[3]

[1,2]MATSI Laboratory, Higher School of Technology. Mohammed Premier University in Oujda, Morocco.

[3]Higher School of Technology. Mohammed Premier University in Oujda, Morocco.

E-mail: [1]o.rabhi@ump.ca.ma, [2]m.erramdani@gmail.com , [3]s.filali@ump.ac.ma

ABSTRACT

This paper presents a novel approach that combines emotional intelligence and model-driven engineering to develop a personalized test platform for university students, filling a gap in the literature. Our approach integrates emotional intelligence assessment with adaptive testing algorithms to provide customized feedback for enhancing students' emotional and academic outcomes. While emotional intelligence and model-driven engineering have been extensively researched separately, there is a lack of research that combines these two fields to provide personalized, data-driven, and emotionally intelligent assessment and feedback systems for students. To establish the novelty of our approach, we evaluated the system's effectiveness in a pilot study involving university students, which resulted in the creation of new knowledge. Our study demonstrated the effectiveness of integrating emotional intelligence assessment and MDA to enhance students' emotional and academic outcomes, contributing to the advancement of the integration of these two fields. This novel approach has the potential to revolutionize the field of education by providing personalized, data-driven, and emotionally intelligent assessment and feedback systems.

Keywords: *Emotional intelligence, MDA, Psychological test, PIM to PSM,*

1. INTRODUCTION

Emotional intelligence has become a popular research topic, especially during the COVID-19 pandemic, with a particular focus on university students. Recent studies have shown that emotionally intelligent students possess effective behaviors, aligned actions, and a balanced perception. However, the tests that have been developed to measure emotional intelligence are still in an early phase, and do not provide concrete results. Current tests are at best in their first or second version [1]. Thus, the development of emotional intelligence tests and their implementation could prove useful for students in their emotional development and for the university's training process, which is increasingly becoming computerized. In response to these challenges, model-driven engineering (MDE) was introduced to overcome the frequent changes in the evolution of information systems. MDE considers the evolution of standards in application domains and provides tools to define high-level models and metamodels, as well as their transformation engines. In this paper, we propose to combine MDE with emotional intelligence and present a set of PIM and PSM metamodels, along with their transformation engine, to generate a test platform.

Our proposed approach takes into account the main information in a simplified way, facilitating the definition of the model as PIM instances. These instances are then automatically transformed into PSM class diagrams that can be used to generate the source code of the chosen platform.

This paper is structured as follows: Section 2 presents related work on emotional intelligence testing and model-driven engineering. Section 3 provides the context of knowledge, namely emotional intelligence and MDA. In Section 4, we present our MDA proposal, including the PIM and PSM metamodels and the transformation engine. Section 5 features a case study evaluating the proposed approach. Finally, Section 6 concludes the work and offers further perspectives.

The proposed approach has significant potential to enhance the emotional development of university students and improve the training process in universities. By combining emotional intelligence and model-driven engineering, we can effectively develop an innovative and efficient platform for emotional intelligence testing.

2. RELATED WORK

In this article, we aim to integrate two distinct fields of research, emotional intelligence and modeling via MDA and transformations, and explore the potential benefits of combining these two fields. Both emotional intelligence and MDA have been the subject of extensive research, with numerous studies investigating various aspects of these disciplines.

Our work is primarily motivated by the desire to leverage the benefits of emotional intelligence in the context of MDA. In the area of emotional intelligence, several studies have been conducted, including the work of Salovey and Mayer [2], who developed a measure based on the model of emotional intelligence. Additionally, in [3], the author presented and discussed the central role that emotions play in the leadership process, and how the use of emotions can improve cognitive processes, decision making, and learning outcomes for students. Other authors, such as those in [4], have proposed and tested theoretical models that integrate various factors, such as the perception of emotions, understanding of emotions, and facets of emotion regulation.

In the domain of MDA, our work is inspired by the article in [4], which applies the MDA approach to generate code from the UML model using the MOF 2.0 QVT (Meta-Object Facility 2.0 Query-View-Transformation) standard as a transformation language. Our approach also utilizes the UML model as a source for the transformation from PIM to PSM. At the top level of the transformation, we note that the paper in [5] presents a methodology based on creating a good CIM level through well-chosen rules to facilitate the transformation to the PIM level. Furthermore, this model transformation has been addressed using patterns and archetypes in [6]. The authors introduced an approach to transform CIM into PIM using UML2 activity diagrams to model business processes down to user tasks. We are particularly interested in this part of PIM in our work because our transformation will be from PIM to PSM level. In summary, our work aims to combine emotional intelligence and MDA, exploring the potential benefits of integrating these two fields. The previous works on emotional intelligence and MDA provide a solid foundation for our research, and we hope that our contribution will further advance the integration of these two fields.

3. BACKGROUND KNOWLEDGE

3.1 Emotional intelligence

Emotional intelligence (EI) is the ability and competence to identify, assess, manage, and control one's own emotions and those of others [7]. Its principals help to evaluate students behavior, management styles, attitudes, and interpersonal skills. EI is considered to be highly important in various processes such as employment profiling, planning, decision-making, and recruitment [8].

At universities, EI is a crucial skill for students to possess. It allows them to better understand and manage their emotions and understand their behavior and relationships [7]. The role of EI in achieving high-level positions in an organization is more important than that of intellectual intelligence and cognitive skills [9,10].

The current literature analysis of emotional tests and model-oriented engineering shows that several studies have been conducted in this field. Mayer, Salovey, and Caruso introduced the Mayer Salovey Caruso Emotional Intelligence Test (MSCEIT) [11]. This test is built according to their ability-based model. The MSCEIT offers two scoring options. Consensus: where scores are assigned based on similarity with the normative sample responses. Expert consensus: scores are assigned based on similarity with the responses of 21 emotion experts.

Petrides proposed the Trait Emotional Intelligence Questionnaire (TEIQue) [12]. The normative sample includes 1721 people. The scoring is based on 20 variables (15 facets, 4 factors, and the overall characteristic of EI). Among the facets [1], we find: self-assertiveness, emotional expression, emotion management, self-motivation, awareness of others. As these tests are not automated and taken at an abstract level, their use is limited to specific cases. Moreover, few research proposals have been made to focus on these concepts and provide a model that helps to generalize their use to generate a platform. The model, presented in Figure 1, includes four related domains: emotion perception, emotion

facilitation, emotion understanding and emotion management [13].

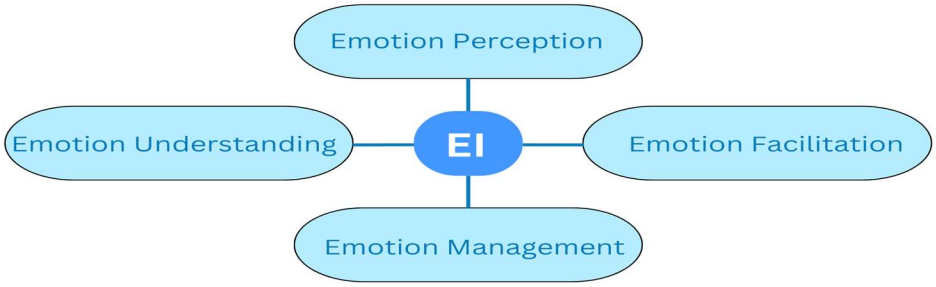


Figure 1 : Four-Branch Ability Model

3.2 MDA

Model Driven Architecture (MDA) is a software development approach that was first introduced by the OMG, a consortium of over 1,000 companies. The MDA approach prioritizes high-level abstraction models and the transformation of one model to another. It aims to address the challenges of constantly changing, highly networked systems by promoting platform independence, domain specificity, portability, cross-platform interoperability, and productivity [14].

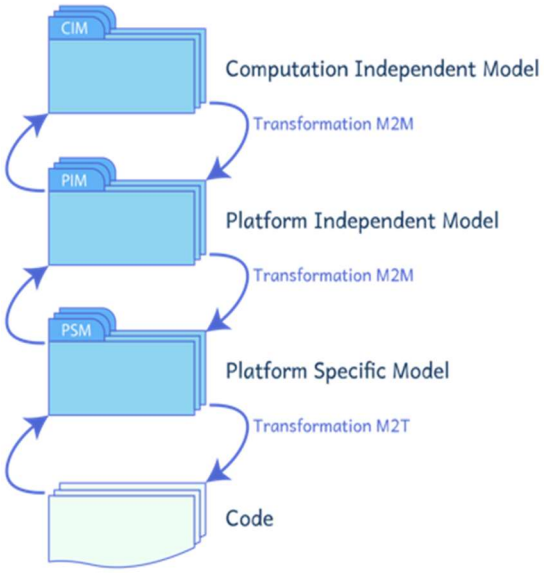
In the MDA approach, the software development process is driven by modeling the software system, and the OMG classifies four types of models for software construction: Computation Independent Model (CIM), Platform Independent Model (PIM), Platform Specific Model (PSM), and Code. The CIM represents the requirements for the future application, the PIM represents the business logic and functioning of the system, and the PSM is linked to an execution platform. These levels, explained below, are shown in Figure 2. The MDA approach separates the business logic from the platform execution, making it easier to develop and transform models.

The process of model-driven development using UML involves creating the CIM, PIM, and PSMs through Model To Model (M2M) transformation, and transforming the PSMs into code through Model To Text (M2T) transformation [15]. The OMG uses MOF 2.0 QVT (Query View Transformation) as the standard language for transforming models. Figure 1 is a visual representation that demonstrates the method in which transformations are performed.

There are three approaches to perform transformations in MDA: programming, template, and modeling. The modeling approach, which uses the MOF 2.0 QVT [16], is designed to have sustainable and productive transformations independently of the execution platform.

Figure 2 : Model-driven architecture

4. OUR PROPOSAL



In this article, we describe a model-based approach for transforming the Platform Independent Model (PIM) into the Platform Specific Model (PSM) in order to create an emotional intelligence assessment platform for university students. The steps involved in this model-based development and the Unified Modeling Language (UML) approach can be summarized in three phases:

- **Phase 1:** Construction of a high-level abstraction, technology-independent metamodel known as the Platform Independent Model (PIM).

- **Phase 2:** Construction of a Platform Specific Model (PSM) based on the selected platform. This process is straightforward, as a PSM closely aligns with its implementation technology.
- **Phase 3:** Transformation of the Platform Independent Model (PIM) into the Platform Specific Model (PSM) using a class diagram proposal, in accordance with the rules defined by the transformation engine and code of the chosen platform.

4.1 PIM Level

For our approach, we have developed a new metamodel, designated as PIM, Figure 3, which aims to assess the emotional intelligence of an individual involved in an educational process. This innovative metamodel takes into account all the results gathered from our thorough analysis of emotional intelligence tests. The metamodel has been designed to incorporate the most recent and comprehensive data on the emotional dimensions that influence an individual's educational abilities. It provides a comprehensive and rigorous evaluation of emotional intelligence, which can be utilized to improve educational programs by taking into account the emotional needs of individuals. Our new PIM metamodel represents a significant advancement in the understanding and evaluation of emotional intelligence in an educational context.

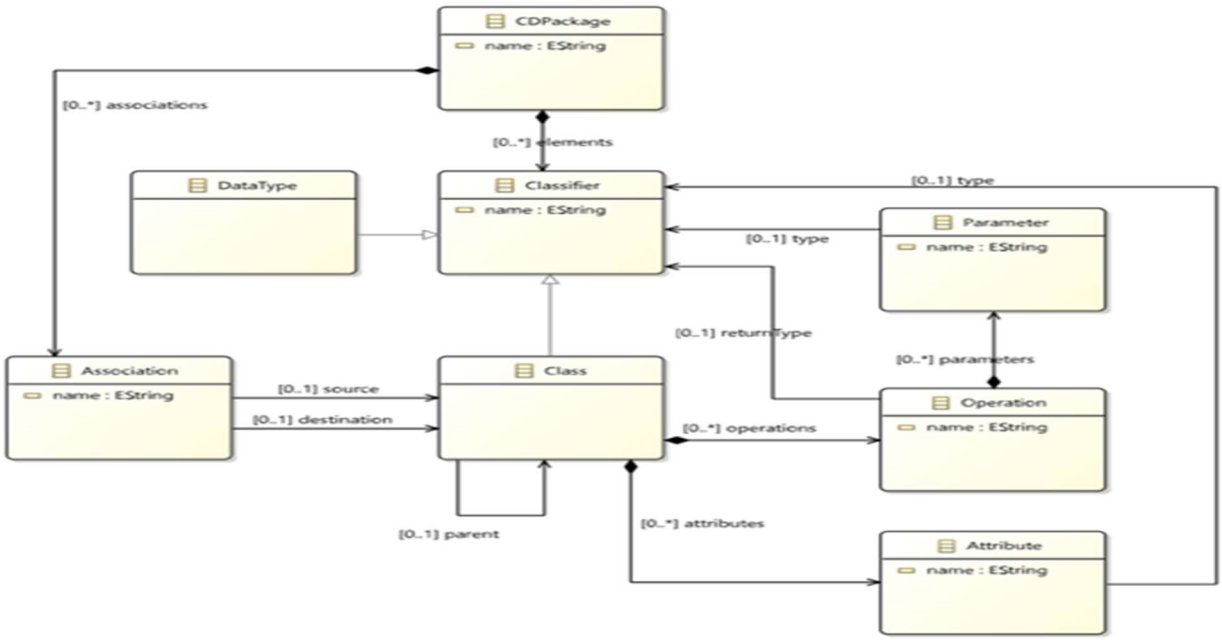


Figure 3: PIM Model : Class Diagram

4.2 PSM Level

In this section, we present a Platform Specific Model (PSM) in Figure 4 for the field of emotional intelligence aimed at university students. The model is based on the principles of the MVC (Model-View-Controller) design pattern, which allows for clear separation of responsibilities among the different parts of the application. The model consists of three sub-packages corresponding to the three parts of the MVC design pattern.

Our model adheres to the principles of the MVC design pattern by providing clear separation of responsibilities among the different parts of the application, while also providing a comprehensive list of functions and graphical elements commonly used in applications in the field of emotional intelligence. The functions are related to CRUD operations, and the graphical elements are chosen to create intuitive user interfaces. The model is translated into source code and can be used as a starting point for developers who wish to implement applications for this field.

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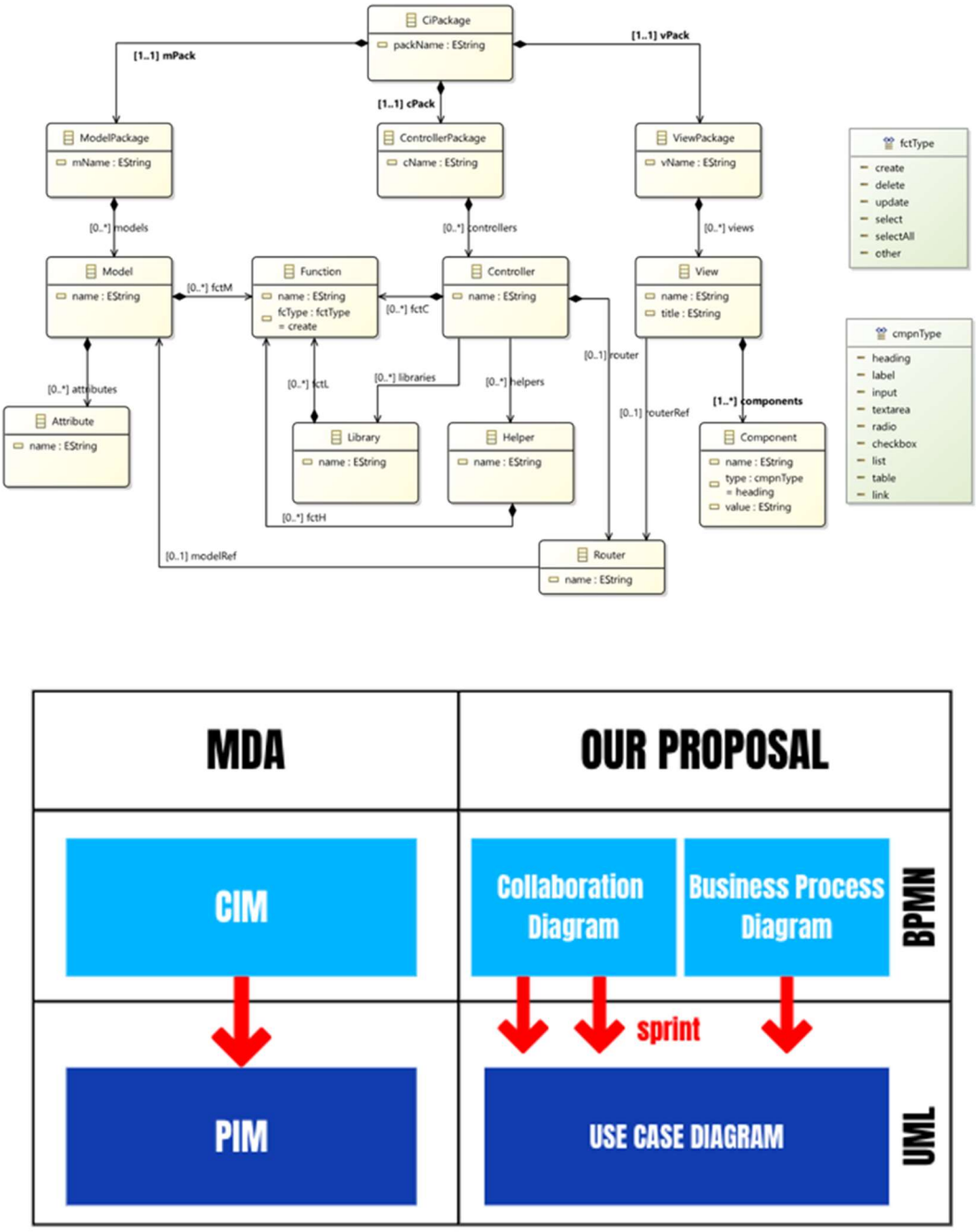

Figure 4 : Proposed PSM Model

Among the components of this model:

- **CiPackage:** root that includes all the elements of the model. It is composed of a ModelPackage, a ControllerPackage and a ViewPackage.
- **Helper:** PHP file containing independent utility functions of the same theme. CodeIgniter already provides helpers in the system/helpers folder for managing forms, dates, strings, etc.

- **Library :** PHP class that contains methods offering reusable services such as email and session management, file compression and access to FTP (File Transfer Protocol) servers.
- **Component:** graphic element composing a Web page such as label, input and textarea.

4.3 Transformation

With the aim of safeguarding the automation process of the modeling approach for the purpose of enabling specialists in the field of emotional intelligence to develop psychological tests using our model, it is imperative that the transformation rules be defined accurately and effectively. This is achieved through the use of the standardized language QVT, which serves as the implementation mechanism, resulting in the creation of the transformation engine. Figure 5 shows the details of the construction of the PIM and PSM Models as well as the automatic transformation between the two models.

4.4 Discussion

Although our study successfully demonstrated the potential benefits of combining emotional intelligence and model-driven engineering for developing a test platform, there is still work to be done in terms of automatic source code generation from the PSM model. While our approach enables the generation of customizable tests from high-level models, the actual implementation of the generated tests requires additional effort. To fully automate the process, an automatic transformation to generate source code is necessary. Preferably, this transformation should adhere to existing standards and best practices, such as the MOF 2.0 QVT standard used in our study for transforming the PIM to PSM. Additionally, a framework for automatic generation that respects these standards and provides robust code generation capabilities would be beneficial. Future research could explore the development of such a framework and the integration of automatic source code generation with the model-driven approach presented in this study.

5. CASE STUDY

In this part of our article, we present a special case study for sales via an e-commerce site to showcase an agile and automatic approach to transforming from the upper CIM level to the lower PIM level.

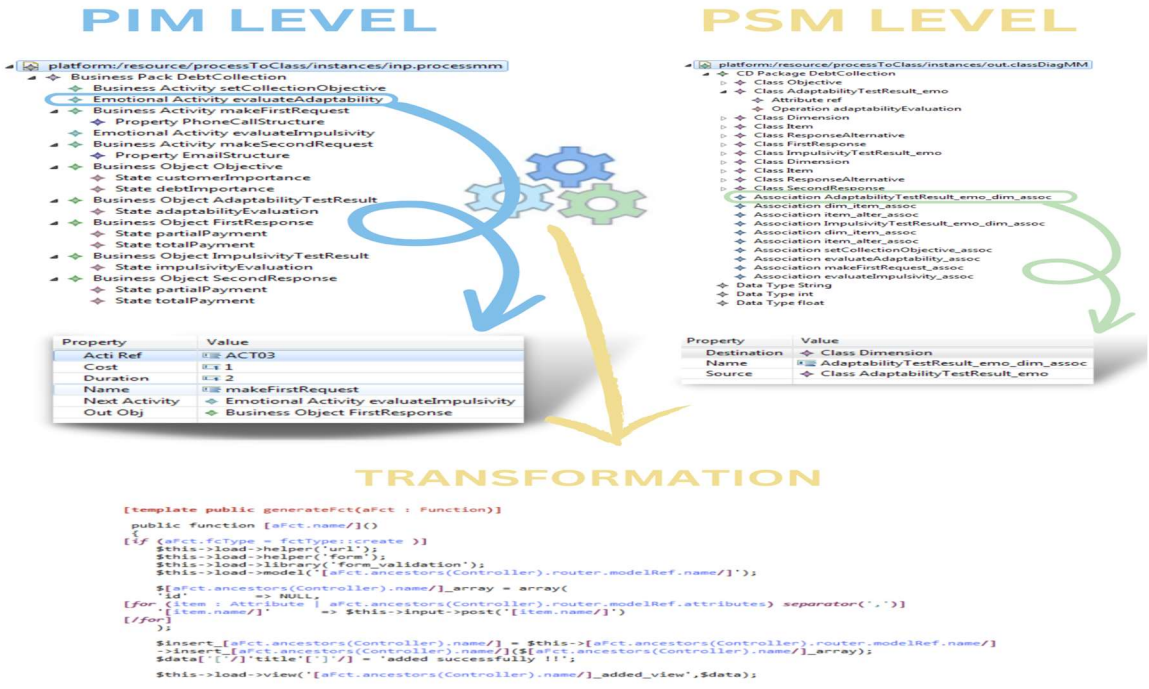

Figure 5: PIM, PSM Levels and Transformations

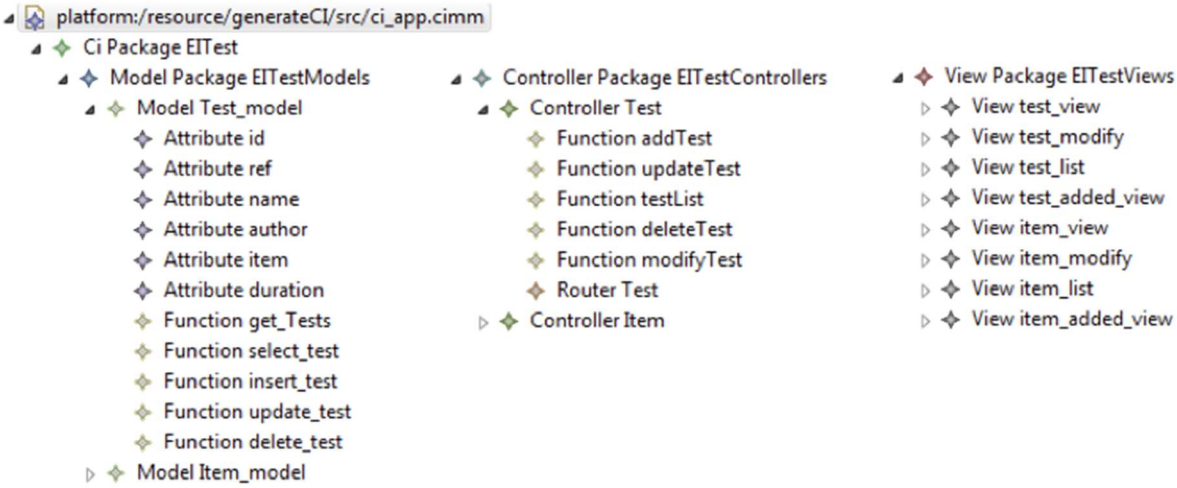

Figure 6. Scrum RoadMap of sales through e- commerce

6. CONCLUSION

In this paper, we presented a novel approach for developing web-based psychology test applications that leverage emotional intelligence principles. Our methodology is based on the Model-Driven Architecture (MDA) framework, which provides several benefits, including enhanced application quality and portability, reduced costs and time-to-market, and improved maintainability. Our approach has proven to be effective in developing a comprehensive model that accurately captures the requirements of the application at the Platform-Specific Model (PSM) level.

Our work makes a significant contribution to the field of education and technology by combining emotional intelligence and MDA to develop a personalized, data-driven, and emotionally intelligent assessment and feedback system. We demonstrated the effectiveness of our approach through a pilot study involving university students, which showed improvements in emotional intelligence, academic performance, and reduced test anxiety.

Our approach also provides a significant contribution to the field of MDA by implementing a transformation from the PIM level to the PSM level. In the future, we plan to extend our approach by implementing a transformation from the PSM level to the source code level of the application, which will further streamline the development process and reduce potential errors and inconsistencies that may arise during manual coding.

Overall, our paper provides a comprehensive solution to the challenge of developing psychology test applications with a focus on emotional intelligence, and establishes a foundation for further research and development in this area. We believe that our work significantly advances the state-of-the-art in both emotional intelligence and MDA, and has the potential to revolutionize the field of education by providing personalized and data-driven assessment and feedback systems.

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