Modeling Emotion Oriented Approach through Agent-Oriented Approach

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Abstract— eLearning is introduced to promote self-learning anytime and anyway. To date, various components have been added into an eLearning platform to produce an interactive and engaging eLearning platform. Among an interest, component is embedded emotion into the eLearning system. While emotion is paying much attention nowadays, there is lacking a systematic way to model emotion-based eLearning. Without the systematic approach, it is hard to debug, design and develop an emotion-based e-learning system. This paper introduces emotion goals through the agent-oriented approach. Besides, we demonstrate how to design an emotion-based quiz master as an embedded emotion element for the eLearning system through the proposed modeling approach. This thesis suggests a standardized way to model an emotion-oriented application through Agent-Oriented Modelling (AOM). The AOM is extended to guide the elicitation, analysis, design and implementation of an emotion-oriented application, a kind of interactive application. With the emotion model, it can serve as a guide to design, redesign, discuss the emotional elements among the software development team. This is important for better debugging and project management, especially for emotion, led applications.

Keywords— emotion; agent-oriented methodology; eLearning; design.

I. INTRODUCTION

With eLearning, students can create flexible learning opportunities [1]. These include flexibility in time, place and pace of learning [1]. They can choose to learn at the time, place and pace based on their preferences. To date, the development of a quiz can be derived from simple multiple-choice questions [2], true or false, drag-and-drop [3], selecting from a dropdown menu [3] to advanced interactive Quiz MASter [4], Quiz MASter emotion-based [4].

To date, various components have been added into an eLearning platform to produce an interactive and engaging eLearning platform. Among an interest, the component is embedded emotion into the eLearning system. Student engagement is understood to be an essential benchmark and indicator of the quality of the student experience for online learning [5]. From the findings, talking head, multiple presenters, background music, whiteboard animation, demonstration and studio filming are the design attributes that influence the learners' emotions [6].

While emotion is paying much attention nowadays, there is lacking a systematic way to model emotion-based eLearning. Without the systematic approach, it is hard to debug, design and develop an emotion-based eLearning system. The critical issue is how to relate the emotion to software analysis, design and implementation? This paper introduces the emotional goal through the agent-oriented

approach. Besides, we demonstrate how to design an emotion-based quiz master as an embedded emotion element for emotion-oriented application through the proposed modeling approach. The emotion-based quiz master is a virtual character that will interact with the students through various emotional characters.

Agent-Oriented modeling (AOM) is an agent-oriented methodology that uses the notion of agent or actor in all stages of its process [7]. As the virtual character need to engage with the users, modeling the virtual character as an emotion-oriented application is worth to explore. In AOM, various agent models have been introduced. These include goal models, Role and Organization Models, Domain models, Agent and Acquaintance Models, Interaction Models, Knowledge Models, Behavior Models and Service Models [7]. To date, agent-oriented modeling has been adopted in ICTD4 [7], 3D virtual characters, eCommerce [8], collaborative learning etc. However, exploring AOM in modeling an emotion-oriented application is not yet explored.

Learner engagement claims to be an essential indicator of the quality of the student experience for higher education [9]. There are several definitions of engagement. According to The Glossary of Education Reform, learning engagement is the amount of attention, curiosity, interest, optimism, and passion that learners show during learning. Also, engagement can be described as the concentration of the user

in an application [10]. Work has been done to adapt a mechanism for emotion-oriented application development. This study aims to reduce the complexity in the emotion-oriented application by introducing the new notation in the software process within software engineering. The emotion-oriented application can be described as an application that supports or consider the emotional need of what user want to feel during the design of the software application [11]. The emotional goal is introduced first by Leon Sterling to capture and model the essential emotional need of the systems [11]. Figure 1 shows the emotional goal present the emotion with heart shape. The emotional goal is defined as the way people feel about the system and captures their engagement in the more significant socio-technical system [11].

Fig. 1 Notation for functional, quality and emotional goals [13]

Negative emotion in emotion models is described when some people express what they do not want in their requirements rather than what they do want as in Figure 2 [11].
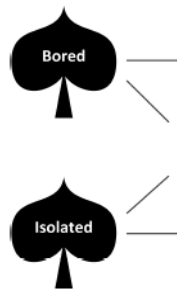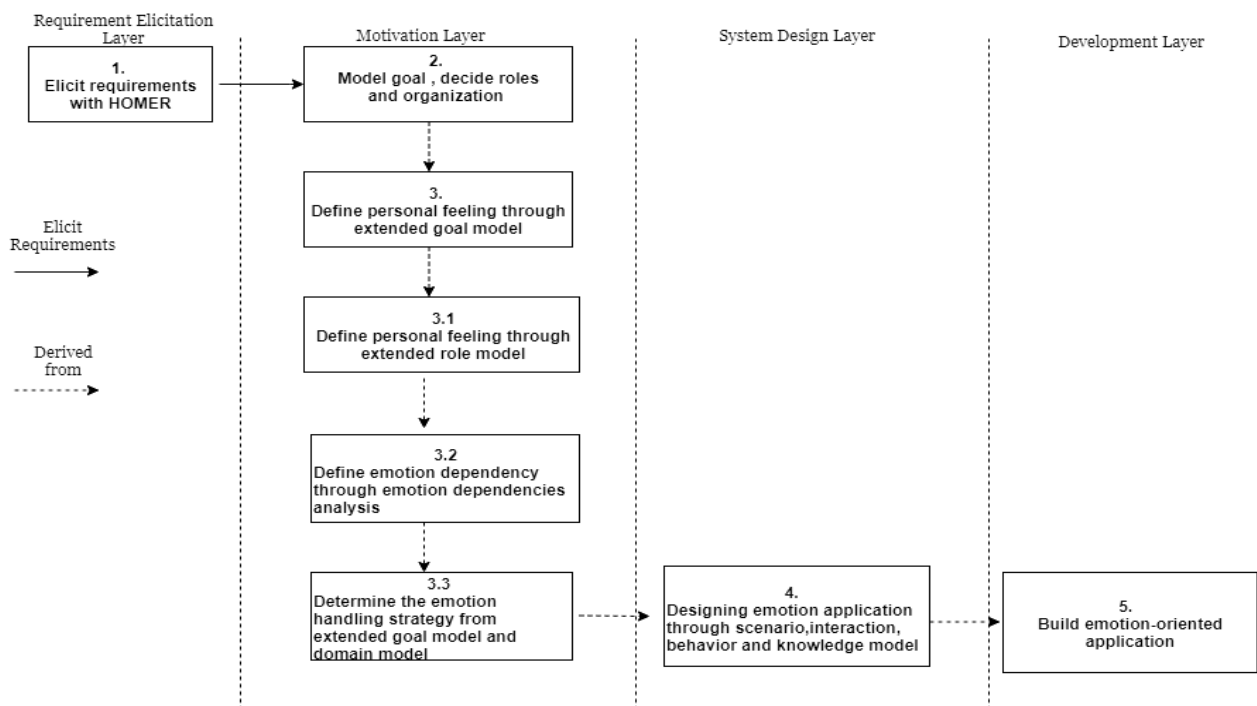

Fig. 2 Negative emotion

In other words, people tend to express what they do not wat as requirements in the system [11]. This research aims to introduce agent-oriented modeling to the emotion-oriented application model. By having a complete set of models for emotion-oriented application, it can serve as a guide to design, redesign, and discuss the emotion elements among the software development team. This is important for better debugging and project management especially for emotion-oriented application. The specific of the AOM is depict in the following section.

II. MATERIAL AND METHOD

A. Development cycle of extended AOM

Figure 3 showcased the extended AOM methodology with an emotion-oriented application. Subsequently, both user and other stakeholders should capably understand these models with a list of steps and details Requirement phase depict the overall view of the system has been designed and implemented, but do not describe in detail for development and verification.

Under Requirement, elicitation layer does consist of the step to elicit requirements with HOMER. The motivation layer does consist the several models to transform the user requirement into several models. These include goal model, role model ,organization model , define personal feeling through extended goal model and role model, define emotion dependency through emotion depended analysis , determine the emotion handling strategy from extended goal model and domain model .The system design phase consists the notions required for modelling and designing the emotion-oriented application. Also, it does show more concrete knowledge about the agent involved in the system. Under System Design phase does consist scenario model, interaction model, behavior model and knowledge model [11].

Fig. 3 Development cycle of extended AOM

B. Elicit requirement with HOMER

There are two activities that involved in this step-in order to collect the requirements regarding the AOM from the users. These include conduct the interview meeting and specify the AOM through HOMER answers. The interview meeting is executing to elicit user requirements by using the HOMER questionnaire technique. The answers derived from interview are used to specify the extended agent-oriented modelling like the define personal feeling through extended goal model and role model.

C. Model Goal, Decide Roles and Organization

This step is used as the primary tool to understand the problem or the propose of the system. Understand the problem and purpose of the system is important for application [11]. Modification of goals and roles are taking place from the elicitation answer. This element in the goal model are derived from Question *1a : What is the problem of*

the system?, Question 1b:Which role(s) to pick in order to clarify the problem , Question 2a:What is the purpose of this position ?and *Question 2b :Are there any quality requirement need for certain purpose?*Figure 4 shows the sample of overall goal model for the QuizMASter application. QuizMASter is an interactive educational game that is designed based on the TV quiz show, where the game show host will present questions to a group of contestants who are competing [4]. Meanwhile, emotion-based QuizMASter is a quiz application involved the virtual character that interacts and engages with the students through various emotion elements and feedback during the quiz [4].

Interactive quiz application like QuizMASter application can provide an interactive and engaging environment for the students. Thus, the problem statement of the model is to Handle Quiz which being translated into main goal (high level goal) has found in Question 1a.
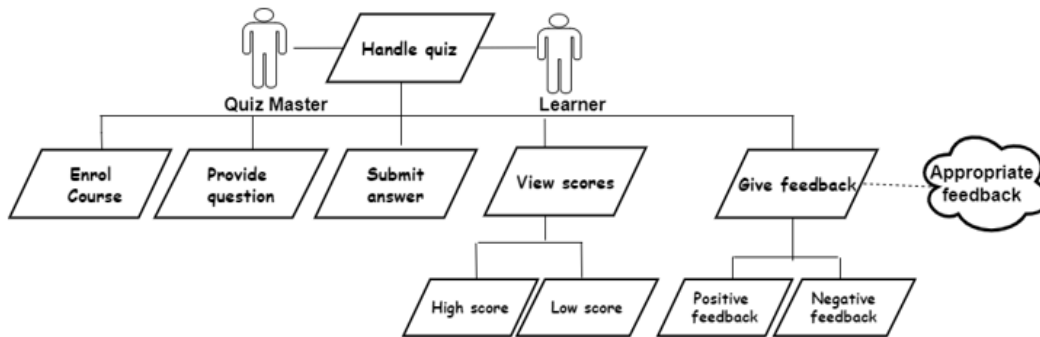

Fig. 4 Example of overall goal model

Next, Figure 5 shows how relationship between the learner and the QuizMASter is modeled in an organization model where the learner is peer on a QuizMASter to answer the quiz.
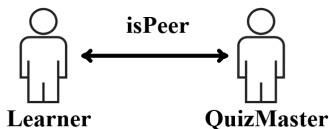

Fig. 5 Example of organization model

D. Define Personal Feeling through Extended Goal and Role Model

Understanding the feeling of the people is needed for the acceptance of a system [12] uncover new requirements and to improve the system [13]. When achieving a goal, one will feel positive and other will feel negative [13]. In 1980, Plutchik constructed a wheel-like diagram of emotions. In this thesis are focus on several element on how to use the Plutchik's Wheel of emotions. There are eight basic emotions in the wheel of emotions. These include joy, trust, anticipation, fear, surprise, sadness, disgust and anger.

The figure 6 shows the example of the emotion in related to user satisfaction towards achieving the goal which are elicited from *Question 4a What feeling that the role wants to feel when achieve the goal and sub-goal* and *Question 4b*

*What feeling that the role does not want to feel when achieve the goal and sub-goal?*Here, it can depict the QuizMASter application can provide an interactive and engaging environment for the students. Thus, the problem statement of the model is to *Handle quiz is* translated into main goal. Several purposes of system have been translated into functional goal. These include *Enrol course, Provide Question,Give feedback,Submit answer, and View scores.*

Here, it can interpret the question that has being provide should make the learner feel *interest. If* the *Provide Question* unable to capture the feel of *interest* in the learner, they will feel *boredom* when answer the questions. *Boredom* are the emotional threat or negative feeling that need to be avoided in the QuizMASter application. In the context of QuizMASter, any negative feeling that the learner does not want to feel was considered as a negative. Learner or QuizMaster feel *joy* and/or *curiosity* while view the high scores. Also, the learner or QuizMaster feel surprise while view the low scores. The emotion is no exhausted, but it is based on our experience in dealing the quiz.Next, it can interpret the QuizMaster or Learner feel joy while receive positive feedback and QuizMaster or Learner feel interest during receive negative feedback. *Distraction* and *annoyance are* the emotional threat or negative feeling that need to be avoided during give the negative feedback.
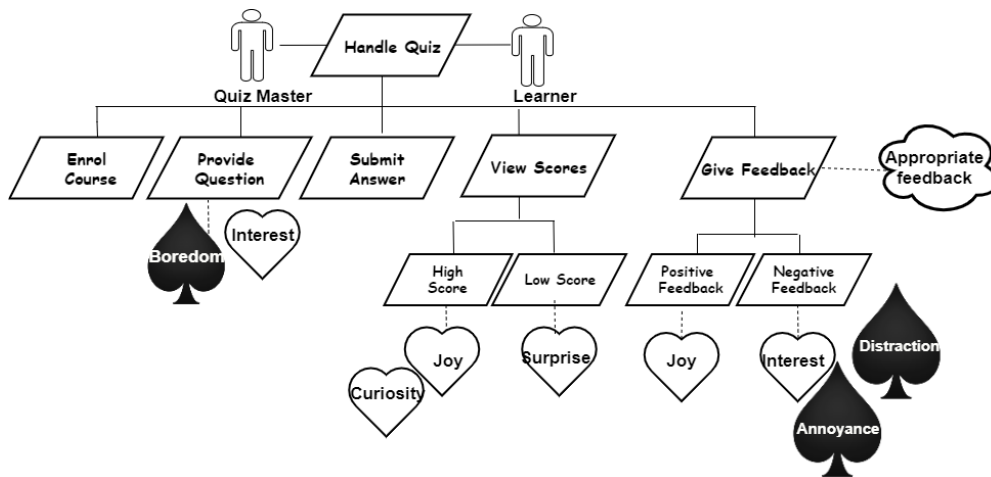
Fig. 6 Example of emotion-oriented goal model for QuizMASter

E. Define Emotion Dependency through Emotion Dependencies Analysis

Tropos is an agent-oriented software development methodology that uses concept of actor, goal and dependency to model early and late requirements, and architectural and detailed design [14]. The main actors are Learner and QuizMaster as shown in figure 7. Learner depends on QuizMaster to fulfill their goal to give feedback and view score. QuizMaster depends on Learner to submit answer.The Learner is depending on the QuizMaster to feel joy during receive positive feedback and interest while receive negative feedback. High score lead the learner to feel joy and curiosity while low score lead learner to feel surprise.This dependency are derived directly from *Question :Elaborate more which actor is depending on the another actor to gain some feeling?*
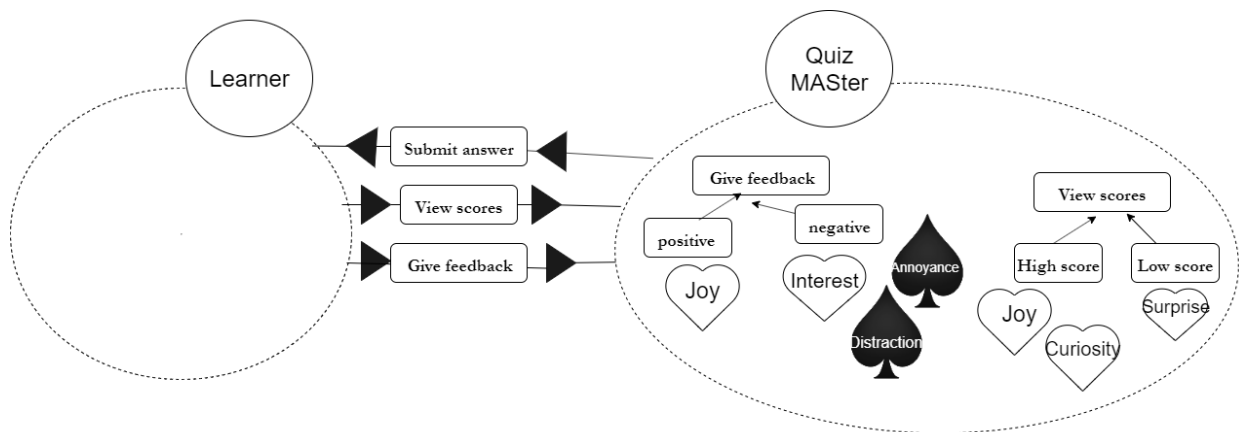

Fig. 7 Example of emotion-oriented goal model for QuizMASter

F. Determine the Emotion Handling Strategy from Extended Goal Model and Domain Model

Once the source of the emotion is identified, we are further identifying the strategy to handle the emotion. This step include identify the study of the emotion they demonstrated in the goal model.This emotional goal in the domain model are derived directly from *Question 4d. How do you handle the emotion?* Figure 8 presents example of domain model for QuizMASter. It does shows domain entities like *question, answer, feedback message, emotion,sound,hand gestures, background, body movement* and *face expression* for studying QuizMASter behavior.

The domain also includes roles of *QuizMaster* and *learner* that becoming grounds for actions. QuizMaster as one of the roles models set and receive the answer question. The learner will give the answer and the way answer being display should make learner feel motivate and/or stress. If learner get high score, will make learner feel motivate while if the learner gets the low score, will make learner feel stress. In turn, the learner will study more as a result of stress. Once submit the answer will affect the *Score* or *feedback message*. The QuizMaster will feel joy and/or sad based on the score. The score results will lead to *Rewards, Background, Emotion, Sound, Hand gestures, body movement a*nd *face expression.*
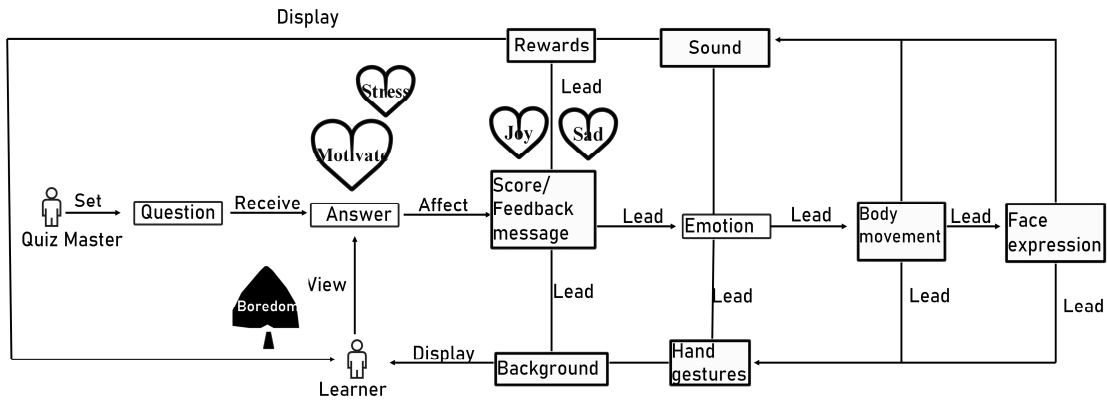
Fig. 8 Example of an emotion-oriented domain model for QuizMASter

G. Designing Emotion-Oriented Application

This step exemplifies the process of modeling through the scenario model, interaction model and behavior model for emotion-oriented application in figure 9, figure 10 and figures 11. In the Design phase, the scenario model is a kind of model that consists of collective activity to elaborate on how the goals can be achieved by agents [11]. The scenario model is extended with a new column to capture emotional goals associated with activities. This element in the scenario model as shown in Table 1.

TABLE I
SCENARIO MODEL VIEW SCORES

View Scores			
Goal	View scores		
Initiator	Learner Agent/Learner		
Trigger	The learner finish answers the quiz		
Desription			
Condition	Step	Activity	Emotional goal
	1	Answer all questions	
	2	Receive a high score	Joy, Curiosity
	3	Receive a low score	Surprise

Once done with the scenario model, the interaction model can be developed. This interaction model does consist of several communicative and physical actions to exchange information when the learner got the wrong answer [11]. For example, figure 9 show the interaction model for the wrong answer. Once the learner submits an answer, it will display a total low score if they get the wrong answer. The result can make the learner or QuizMaster feel surprised. Simultaneously, negative feedback makes them feel interested as they want to know the answer and feedback suggestions. In order to avoid annoying, the model is designed to include sad violin audio that will be playing in the black color background. The QuizMaster will expess their emotion like discomfort body language, do stop gesture, show blushing and sweating, show drop upper eyelid and express worry and wrinkles.
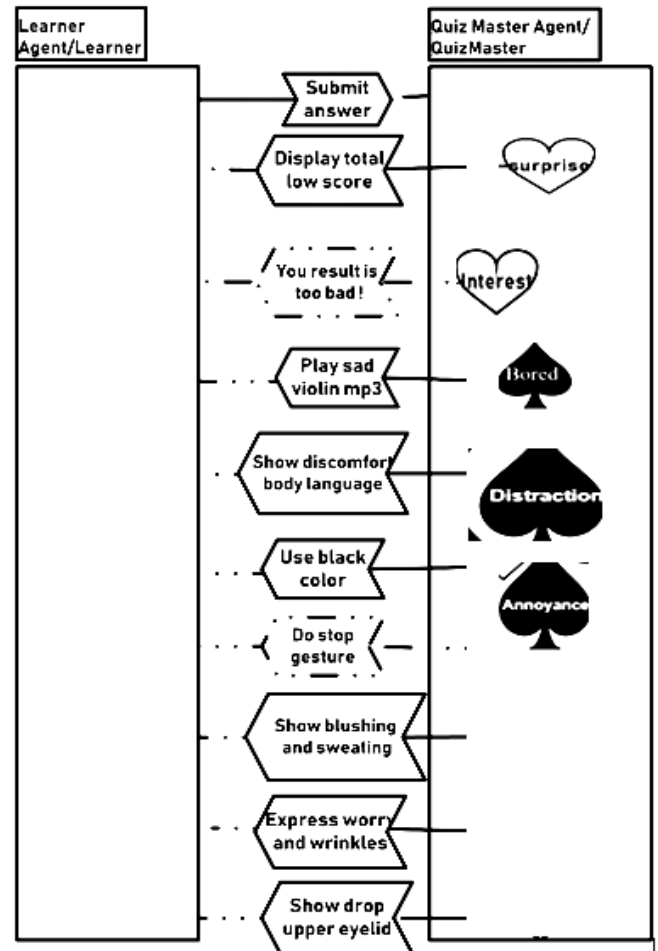

Fig. 9 Example of an interaction model for low score

Once done with the interaction model, the behavior model can be developed. This behavior model describes the internal behavior of specific individual agents do within the application by triggering rules and messages [14]. For example, in figure 10 shows the behavior model for the wrong answer. The human agent initiates the model. Thus, it will start the rule R1 to initiate the activity, result to supply the answer. Within this activity, a new resource feedback message will be updated to trigger the new activity of handle feedback.
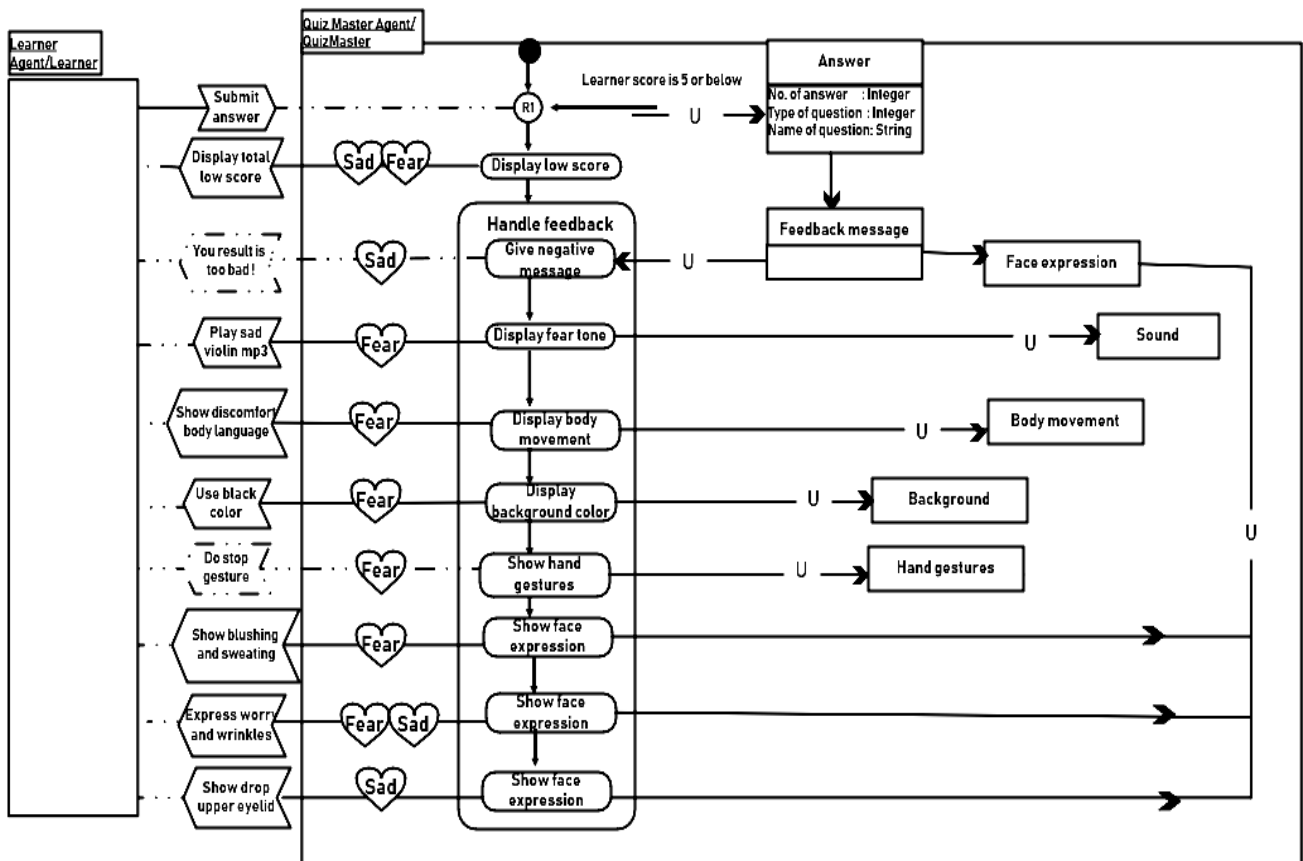
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Fig. 10 Example of behavior model for low score

III. RESULTS AND DISCUSSION

This section contributes to evaluate and develop QuizMASter model through the involvement of a group of 10 postgraduate students who voluntarily participate in the qualitative tests. These students are from the Faculty of Computer Science and Information Technology in UNIMAS and are varied in study majors. These students have prior knowledge or experience in AOM. Nevertheless, they do have familiarity knowledge of AOM methodology. The evaluation aims to check whether the resulting model has satisfied the intended purpose. In this evaluation, an interview is conducted with this group of students to address the following expectations. The answers from the interview session are as below:

A. Can the AOM be used to Model the Emotion-Oriented Application?

All student believes the AOM can be used for the emotion-oriented application. All the students believe the capability of AOM to model the emotion-oriented application especially the goal model and interaction model. Eight students believe both model UML and AOM have a fundamental similarity in terms of their functional requirements. They believe the significant difference can be found in the Behavior model in terms of their notations. There is only one student who believes some of both models look the same and the other one believes the UML and AOM are different as UML is far more on functionality requirement.

B. What are the Improvements that can be added to the AOM?

Some of the students suggest to increase the emotion type, including sad, boring, confuse, furious, skeptical and sarcasm. Two students believe the proposed model was transparent and require no improvement. There is one student who suggest adding negative emotion through all other models in AOM. The behavior model should add more conditions as part of the rule and the agent's mental state.

C. C. Do you think all the emotional goals that have been started are complete for QuizMaster? If not, can you suggest another emotion?

The objective is clear but should include pleased, surprise, excited and cheerful as positive emotions. Use skeptical, furious, confuse, sarcasm and bored as a negative emotion. Mostly is elicited correctly for QuizMaster. Only disgust is not suitable to be included as a negative emotion. To display positive feedback, only positive emotions should be displayed to avoid confusion.

IV. CONCLUSION

This project proposes modeling of emotion-oriented application through the AOM extension. The solution can guide the design and development of emotion application such as emotionally driven eLearning. With the emotion model, it can serve as a guide to design, redesign, discuss the emotional elements among the software development team. This is important for better debugging and project

management. It is worth noting that this paper presents the preliminary work and results on this project. More works are needed to explore the potential of this approach to design an emotion led virtual character systematically.

REFERENCES

[1] Houlden, S., & Veletsianos, G. (2019). A posthumanist critique of flexible online learning and its "anytime anyplace" claims. *British Journal of Educational Technology*, *50*(3), 1005-1018.

[2] Zhao, F. (2019). Using Quizizz to Integrate Fun Multiplayer Activity in the Accounting Classroom. *International Journal of Higher Education*, *8*(1), 37-43.

[3] Gamage, S. H., Ayres, J. R., Behrend, M. B., & Smith, E. J. (2019). Optimising Moodle quizzes for online assessments. *International Journal of STEM Education*, *6*(1), 27.

[4] S. Filzah Zulkifli, CW Shiang, N Jali, M.A. Khairuddin (2019). Modelling emotion expression through agent oriented methodology. *Indonesian Journal of Electrical Engineering and Computer Science,16*(2),972-977.

[5] Redmond, P., Abawi, L. A., Brown, A., Henderson, R., & Heffernan, A. (2018). An online engagement framework for higher education. *Online learning*, *22*(1), 183-204.

[6] Chen, C. J., Wong, V. S., Teh, C. S., & Chuah, K. M. (2017). MOOC videos-derived emotions. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, *9*(2-9), 137-140.

[7] Shiang, C. W., Halin, A. A., Lu, M., & CheeWhye, G. (2016). Long Lamai Community ICT4D E-Commerce System Modelling: An Agent Oriented Role-Based Approach. The Electronic Journal of Information Systems in Developing Countries, 75(1), 1-22.

[8] Shiang, C. W., Halin, A. A., Lu, M., & CheeWhye, G. (2016). Long Lamai Community ICT4D E-Commerce System Modeling: An Agent Oriented Role-Based Approach. The Electronic Journal of Information Systems in Developing Countries, 75(1), 1-22.

[9] Redmond, P., Abawi, L. A., Brown, A., Henderson, R., & Heffernan, A. (2018). An online engagement framework for higher education. *Online learning*, *22*(1), 183-204.

[10] Dirin, A., & Laine, T. (2018). User experience in mobile augmented reality: emotions, challenges, opportunities and best practices. *Computers*, *7*(2), 33.

[11] Miller, T., Pedell, S., Lopez-Lorca, A. A., Mendoza, A., Sterling, L., & Keirnan, A. (2015). Emotion-led modelling for people-oriented requirements engineering: The case study of emergency systems. Journal of Systems and Software, 105, 54-71.

[12] Sherkat, M., Mendoza, A., Miller, T., & Burrows, R. (2018). Emotional Attachment Framework for People-Oriented Software. *arXiv preprint arXiv:1803.08171*.

[13] Kissoon Curumsing, M., Fernando, N., Abdelrazek, M., Vasa, R., Mouzakis, K., & Grundy, J. (2019). Emotion-oriented requirements engineering: A case study in developing a smart home system for the elderly. *Journal of systems and software*, *147*, 215-229.

[14] Sterling, L., Lopez-Lorca, A., & Kissoon-Curumsing, M. (2018). Adding Emotions to Models in a Viewpoint Modelling Framework From Agent-Oriented Software Engineering: A Case Study With Emergency Alarms. In *Innovative Methods, User-Friendly Tools, Coding, and Design Approaches in People-Oriented Programming* (pp. 324-367). IGI Global.