Treating Context Information in a Ubiquitous Virtual Learning Environment (UVLE^{QoC})

Application of metrics for Quality of Context (QoC)

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***Abstract*—Context information captured by computer applications, assists in characterizing the momentary situation in which the user is located. However, during this construction process it must be taken into account not only the context that is used, but also the Quality of the Context (QOC) to be supplied in order to provide a real contribution to user interaction with the environment. This paper presents a study on the development of a ubiquitous virtual learning environment (UVLE^{QoC}), which performs the processing of context information by applying metrics of Quality of Context. The environment also integrates two systems: U-SEA to treat computational context and SEDECA to identify the cognitive profile of the user, adapting the contents and tools of the environment according to the formulated context. The environment will provide a context to guarantee a minimum level of quality, adapting their resources according to the preferences of the users.**

Keywords- context; quality of context; ubiquitous; moodle

I. INTRODUCTION

Given this global scenario that is constantly evolving, it is possible to notice changes in several areas; among them is the education, in which there was a paradigm shift from traditional learning, exclusively in face-to-face classrooms, with the addition of on line tasks. The use of Information and Communication Technologies (ICTs) provided the insertion of new methods and learning techniques, which aim to help users interact with computer applications.

Ubiquitous computing is an example of an emerging area, which, according to Yahya et al. [1], can be described as a learning paradigm that uses ubiquitous computing environments and allows learning to occur "anywhere and anytime". Thus, students have at their disposal in the most propitious time, content suitable for their learning, taking into account the location and context in which it is inserted.

One of the key aspects that are directly linked to ubiquitous computing is context information, which, according to Dey [2], can be defined as any information that can be used to characterize the situation of entities that are considered relevant to the interaction between a user and an application. The origin of this information may come from various sources, such as the analysis of users' cognitive styles on the environment and the speed of the network connection.

Examples of computer applications that use context information are the Virtual Learning Environments (VLE), which have been adapted to suit the needs of users, as seen in the work of [3] and [4]. However, the context used in these environments are subject to imperfections as explained in [5], wherein the context information have a high probability of defect or inconsistency caused by inaccuracies in the acquisition and maintenance of context.

This difficulty may reflect in providing a situation out of date with respect to the current moment the user is located, committing to provide a proper context for the user by the application, thus hindering its interaction with the tool to perform activities. Subarea Quality of Context aims to address this issue, which, according to Krause e Hochstatter [6], can be defined as any information describing the situation of an entity, i.e., its context, and that can be used to determine the value of information for a specific application. Thus, the QoC aids for the final result presented by the tool reflect more realistically as possible the situation where the user is located.

This paper presents a proposal for the development of a ubiquitous virtual learning environment called UVLE^{QoC}, which aims to treat the context information by applying metrics of Quality of Context. The environment will integrate two systems: U-SEA and SEDECA, thus will be captured the context information about connection speed and type of cognitive profile of the user. The information captured pass through an evaluation process, only selecting those who achieve a minimum percentage of confidence, in order to adapt the resources and tools of the environment according to the situation of the user.

The structure of the paper is organized as follows: in section one, an introduction about ubiquitous computing, context and quality of context, the problems in these areas and the proposed work is presented. Section two presents the related work in the area of QOC. Section three the functioning environment, its goals and advantages. Finally, section four presents a conclusion and future work.

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II. RELATED WORK

To assist the course of this study, some related works were evaluated, and are described following:

Yasar et al. [7] aimed to provide efficient communications for the established network; for this proposal, the communication was divided into two phases: the first is focused exclusively on QOC, while the second aims to determine the reputation of the nodes involved in the communication. Their contributions are the definitions of information acceptable limits, in order to ensure a minimum quality, eliminating those that are not within these standards.

In [8], a context-sensitive framework that supports management of QOC in several layers is presented. The authors compared the probabilities of the context to be valid using different analysis algorithms, such as the selection of the newest and largest service relativity. The framework allows to evaluate the context in its raw form, discarding those that are duplicated or inconsistent to provide context information with an acceptable level of quality for applications.

The work of [4] examines the conflicts that can be generated in gathering information to support decisions of adaptive applications. The authors explain that the QOC parameters can be used to perform these tasks, seeking to resolve internal and external conflicts based on two indicators: the probability of correctness and reliability.

The solutions presented above cover various application domains, such as networks of nodes and vehicular service selection, while this proposal is focused in education, with the use of virtual learning environments. The application of metrics of QoC in the information captured on the ubiquitous environment, seeking to enhance the quality of the context provided to users, is presented.

III. PROPOSAL

This study presents a work in progress, which to design a Ubiquitous Virtual Learning Environment with Quality of Context ($UVLE^{QoC}$). In this environment, the following context information is collected: network connection speed and the cognitive profile of the users, applying over them quality indicators to ensure the attainment of an acceptable level of confidence, selecting the information to be used in the formulation of context of the user.

Once the context has been formulated, the virtual environment will modify the materials and tools to display them according to the user preferences. For example, it will be presented only those materials in video format and chat tool instead of long text and forums if the user has selected them in its preferences. The access may be accomplished either via desktop, or via mobile devices, where the environment adapts itself automatically to the device type of the user.

The objective is to create guarantees by using metrics such as precision and reliability, so that the environment use context information to the appropriate momentary situation in which the user is located. Thus, the $UVLE^{QoC}$ performs the necessary adjustments, as the selection of features and interface, to improve the process of interactive learning.

Its architecture can be seen in Figure 1, being divided into four parts. The first part deals with the information extracted from the selected context sources, which were based on the work of [3] and [9].

The data on the speed of the network connection will be extracted from the environment U-SEA [3], through an algorithm that performs the calculation and determines the connection speed of the user. At the same time, the information about the cognitive profile of the user is collected at SEDECA environment [9] by applying two questionnaires. The first one with 16 questions that define the type of cognitive style, and the second one with 13 questions that define the users preferences for the type of materials and tools that are included on the discipline.

Both environments were developed in Moodle [10], in different versions; so, for the development of work, they were integrated into a new environment Moodle in its version 2.4, serving both as a source of context and to make the adjustments made by them.

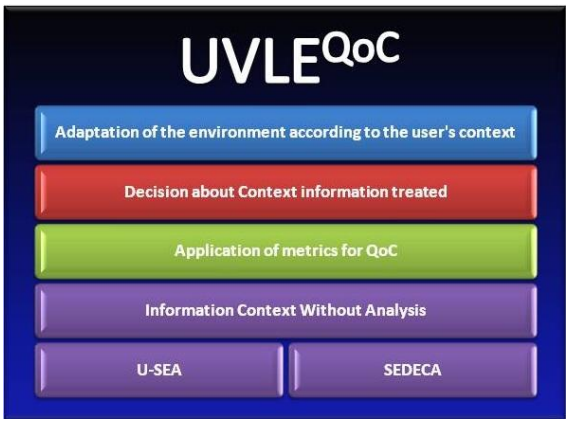

Figure 1 – Architecture of UVLEQoC

The second part is characterized by the application of quality metrics on information collected for the formulation of context. They will be inserted in the calculations and algorithms designed to assess the quality of the information, in which we defined the following quality indicators:

- **Accuracy:** is investigated how these data show the reality, so you can see if the data network connection, cognitive styles and expertise are in line with what is actually happening;
- **Probability of correctness:** it analyzes the probability that a context information is correct;
- **Resolution:** Sets the level of detail that has the context information, so that they can get more and more details about the user's context and thus create a suitable profile;
- **Reliability:** checks in percent values, how the information obtained from the context sources are correct. This check is performed based on pre-defined rules and calculations.
- **Time Accuracy:** are established minimum and maximum periods of time, to check if the collected information is valid and need to be catched again.

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- **Integrity:** Checks if the data obtained from the context sources not suffered unauthorized modifications, which can generate incorrect information.

The preparation of these quality indicators were based on the creation of specific calculations and the use of algorithms based on the work of [7] and [11], for the definition of their operation and application.

The third part corresponds to the analysis of the results obtained with the calculations performed by checking that the verified information has a minimum percentage; so, they can be used in the formulation of the user's context. It is a decision process, where only those who are within acceptable limits will be used to build the user context for the environment.

In the fourth part, based on context information properly treated, are performed all necessary changes in the environment, as the types of materials (videos, slides, longer texts, images, etc.) and the types of tools that (chat, forum, task, etc.) that will be displayed, according to the connection speed of the user and their cognitive profile. If the network connection speed is less than the predetermined value, the environment will adapt itself in order to load resources and a lighter interface, thus seeking to promote a better user interaction with the application. And the materials and tools in the environment are loaded according to the preferences defined by the User in SEDECA. For this, an additional field will be created in the form of insertion of files in the environment where it will indicate the type of material that by entering, for example, if it is a video, image, long text, slides, etc.

As the technology used to develop this environment, the environment Moodle was chosen to be used. Besides the aforementioned environment, a tool called Wamp Server [12], which integrates three technologies (PHP, MySQL and Apache), was chosen to be used. Apache server will act as a venue for the hosting environment. For the database, MySQL will store all information from AVA. Finally, PHP is a programming language used for developing Moodle; therefore, it will be used in the development and implementation of quality metrics.

For adaptation in mobile devices, we will use the Bootstrap theme, which is integrated into Moodle environment, where the selection of the theme to be used is made by the administrator of the environment. In the case of access via workstations or laptops the default Moodle's common interface is exhibited. However for access via mobile devices, the interface is automatically adapted to user's device.

The environment is in development stage and it has been integrated into it the theme Bootstrap to make access from mobile devices and the module U-SEA, which verifies the connection speed of the User. Figure 2 shows the adaptation of the environment to mobile devices using Bootstrap, which presents only those files that are smaller than 400Kb, because the user's connection speed is less than 500Kb. For example, the file template.pdf was not made available to the user, because its size is larger than allowed.

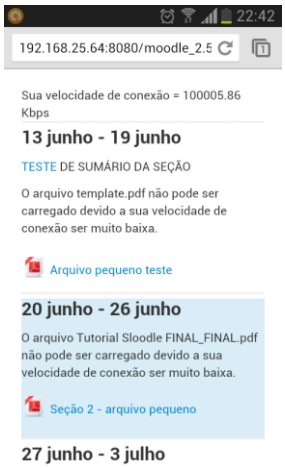

Figure 2 – UVLE^{QoC} accessed via mobile device with the U-SEA

UVLE^{QoC} adapts to the cognitive profile of users and their technological context, with a guaranteed minimum level of quality, with the goal of improving students' interaction with the environment. Thus, materials and resources best suited to their preferences and needs will be inserted by improving the process of teaching and learning, in which everyone will know your style, its technological limitations and be exempt from the difficulties explained by them, as a failure to access the archives of the discipline and the types of materials that are not consistent with their gender.

For example, if incorrect information is collected for the formulation of context and is not to go through an assessment of quality, there is no guarantee of this information has a desired level of accuracy. This may impair the use of the environment by the user, as in the case of adaptation according to their cognitive style and speed of network connection, if the collected information is incorrect, the environment will adapt erroneously damaging user interaction and achievement of their activities.

With the application of QoC indicators, the UVLE^{QoC} provides assurances that the information they are captured, will undergo an evaluation process in order to examine whether these holds the minimum required level of quality and then be used in the construction of the user context and more accurately reflect the reality in which it is inserted.

IV. CONCLUSION AND FUTURE WORK

Context information is used to characterize the state of an object, reflecting the momentary situation in which it is located. One of the problems related to this is the inconsistency that these data are subject to, resulting in reflection of a state that is not consistent with reality. With this, the subarea of Quality Context aims to address this information through rules and algorithms verification in order to ensure that the information used in the construction of the context is correct.

This paper presented a proposal that is developing a virtual learning environment ubiquitous, which handles context information by applying metrics of QOC. In

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addition, it will integrate the modules U-SEA and SEDECA to perform the adaptation of resources and tools of the environment, according to cognitive style and connection speed of the User.

Thus, we seek to guarantee a minimum level of quality for information that are captured, by formulating an appropriate context the momentary situation of the user, performing a proper adaptation of the environment and facilitating their interaction.

As future work, we intend to finish this development environment and to test it with groups of undergraduate and graduate students to validate their implementation and fix the necessary aspects. In addition, we intend to create activities in the virtual world OpenSim to UVLE^{QoC} interconnected through technology Sloodle, so that users can interact with these two environments.

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