A large, ornate decorative border surrounds the central text. It features intricate floral and scrollwork patterns in shades of green, blue, and orange, with a thin orange line forming the inner frame and a thicker dark green line forming the outer frame.

A Novel E–Learning Environment

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**Abstract:**

E-Learning environments today need more than just streaming technology or course content creation tools. High speed internet connections, intelligent mobile devices and App stores make it easy for new features to be added to the E-Learning systems to make it more valuable and interactive. This paper introduces a novel complete E-Learning environment with the addition of important new features like, gamification, augmented reality and wearable devices integration. It starts with an overview for the proposed platform and then its layered structure is explained in details. Then comes the explanation of how to use those novel features in the proposed system. Finally, a conclusion and future work section is presented.

Keywords:.

Descriptors: *E-Learning, Recommendation, Big Data, Gamification, Virtual Reality, Wearable Devices*

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Introduction

As a result of the vast spread of internet and mobile devices, E-learning [1] is becoming one of the needs of humans. Growth in e-learning is occurring because of powerful demand and supply side factors (e.g. cost effective (lower price), need for just-in-time training and allowing for individual differences in learning style) [2]. Existing E-learning environments are being mature, but missing some important features that add huge value to the learning process, especially with the day by day increasing rates of internet speed and cloud access. We are introducing a novel E-Learning environment that maintains all the principal components of standard E-learning system, and adds components to enrich the environment with important features.

Overview

The global overview shows a very high level of the components that form the E-Learning system. It contains a learning content management system (LCMS) that applies standardized protocols as shareable content object reference model (SCORM) with the enhanced version of APIs (TinCan API). It also depends on the online digital repositories (e.g. CORDRA) and supports cloud storage and synchronization. There are many communication channels supported by our proposed environment. Social channels are at the top of the list with other classical communication channels like email and telecom channels like SMS.



Digital course authoring tools were improved to add recommendations to utilize the latest learning concepts. It acts as a platform with different workflows to support different learning systems and concepts (e.g. it contains a workflow to create courses that maintain concept transfer technique not knowledge transfer).

The proposed environment is so flexible and customizable to serve different learning styles. The platform makes it easy, for the learner, to switch among different styles without having long setup time. Styles like social learning, intelligent tutoring systems, personalized learning style and even blended learning are maintained.

Learner profiling and personalization concepts were emerged as a result to switching among different learning styles. A learner should focus on the learning process itself not the style. The profile preferences and customization make it easy to switch back and force among different styles with little tolerance from the learner side. That profile also implies a unified assessment process for the learnt materials, which has a unified frame isolated from the assessment calculation techniques for each learning style.

Big data analytics and reality mining are a must for such systems. We added a whole reporting layer that utilizes the state of the art machine learning techniques to provide decision support reports. The hybrid analysis by (McCreary 2014) [3] was utilized with some customizations to build the big data layer. The reporting layer is not only concerned with conducting reports, it also provides recommendations on different levels (e.g. on the level of learners, courses, assessment techniques, best timings, similar profiles and much more). Both collaborative and content-based filtering [4] are used for recommendation [5].

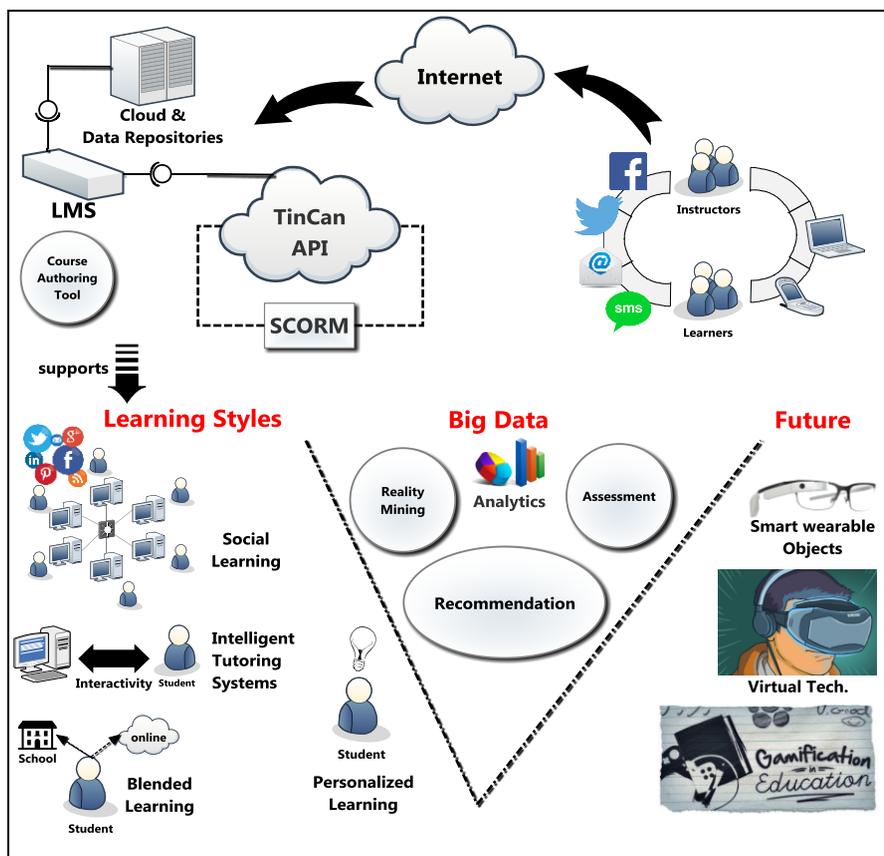


Figure 1: Overview of E-Learning System.

The platform is not restricted to its default services, it enables the 3rd parties' integration and custom business development through an SDK exposing APIs for custom developments.

The novel features existing in the proposed learning system are summarized in gamification support, adding the virtual reality and augmented reality interaction, proposing the 3D simulation and integrating with smart wearable devices (e.g. smart watches, glasses, earbuds, etc...).



Mobile devices native applications complete the cycle of the E-learning system along with real-time alerting platform and LBS system for location related learning activities.

Structure

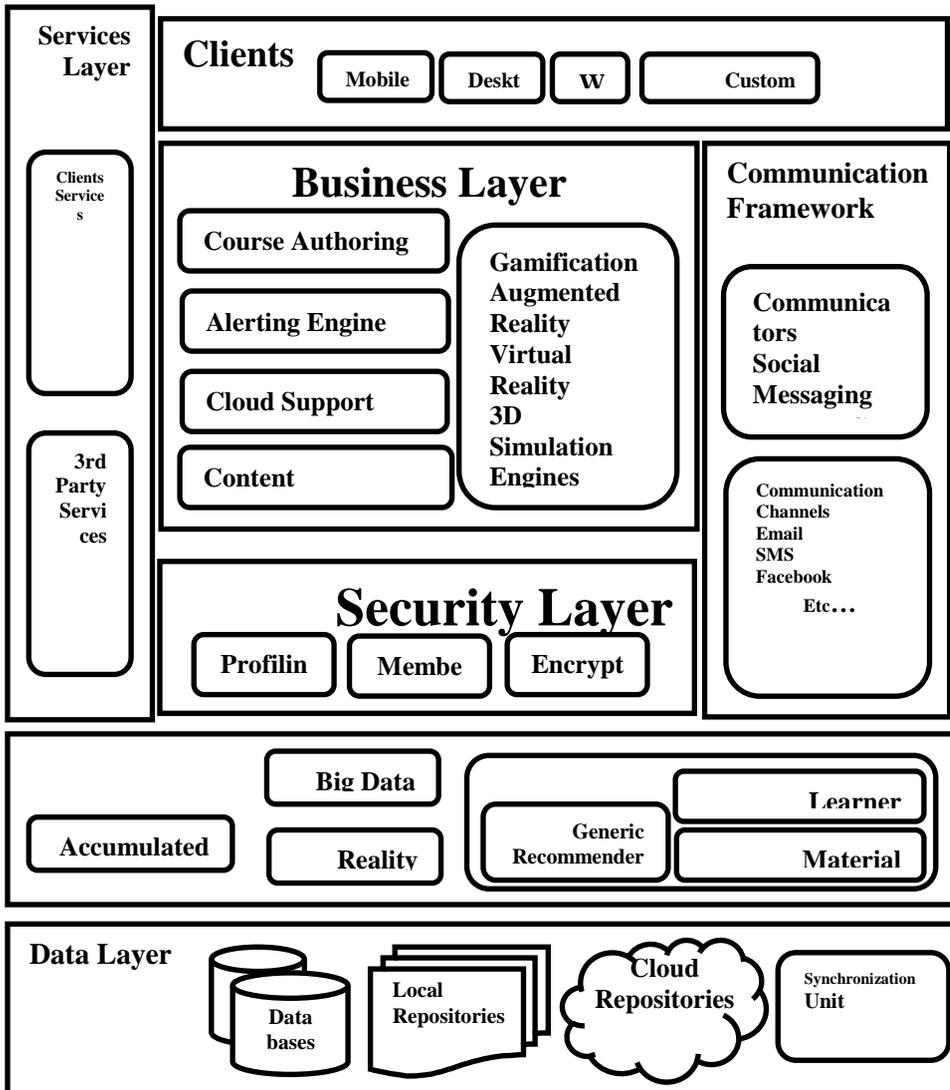


Figure 2: E-Learning System Structures.



The system structure is composed of many layers like data layer, reporting layer, business layer, service layer, etc... as explained in figure 2. The data layer contains all the components and modules related to data management and storage. Local repositories and cloud repositories are used to hold all the related files and data items (e.g. courses' contents). Cloud repositories are customized per user, and imply a synchronization unit to ensure reliability and availability of the data items. The cloud is generic and each learner has his own space as an addition to the general repositories of shareable materials. Huge databases are categorized based on their business use (e.g. learners' history and assessment database).

Huge databases filled with raw and calculated data are used in combination with reporting databases to generate different decision support reports. Different kinds of reporting techniques are existing with their engines in the reporting layer. This layer contains the machine learning algorithms and modules used for big data analysis and reality mining. Also accumulative reporting and learning databases are used in recommendation business. The recommendation engine and all of its intelligence is contained in this layer. Recommendation components are built to be generic and it integrates with other layers components to recommend on different levels, from the learner related courses to the best UI customizations and tools to be used with this style learning.

Security layer is considered one of the house keeping layers of the system. The existence of profiling and social interactions make it urgent for the security support on different interactions levels. Security layer is concerned with such issues for all the software and hardware components used in the system.



Also one of the important layers is the communication framework layer. It is concerned with the internal and external communication business. Internal communication support goes for how different layers exchange data among each others. And what type of communication technique is used (e.g. Sync or Async communication). The interconnection interface for flexible online/offline deployment technique is used [6]. Also what channels are used in sending these data. On business level, communication framework is used to manage connecting people through different channels. It serves social and classical channels, chatting services, telecom services, etc...

Business layer is the main layer that contains most of E-learning system components and engines. Content management system, cloud support, alerting engine and some utilities like course authoring tools are included. Also the engines that add gamification, virtual and augment reality 3D simulation and other business logic engine are included in this layer.

Service layer holds the integration interfaces. It has internal interface for the system components as mobile clients, desktop clients, web sites, etc... It also contain generic SDK APIs for other 3rd parties' integrations (e.g. custom hardware or custom mobile application).

Novel Features

Gamification, augmented and virtual reality and wearable devices integration are the novel features supported by the proposed E-learning environment. The concepts are not new, but how to use them inside a learning environment is what matters here. In the following sections, we will introduce how each of them is used inside the E-learning environment.



Gamification

Gamification is the use of game-play mechanics for non-game applications [7]. Each game mechanic is characterized by three attributes [8]:

- **Game mechanics type: Progression, Feedback, Behavioral**
- **Benefits: engagement, loyalty, time spent, influence, fun, viral effect.**
- **Personality types: explorers, achievers, socializers and killers.**

In the proposed system, there is a profile for each user. That customizable profile works as an avatar of a game. Courses scoring and scoreboards of friends and top scorers in this course are introduced. Scoring is served from a social perspective not the competitive one, i.e. a learner could contact the top scorers, in recent years to benefit from their experience.

The gamification of the user experience and how to access the information is an important part of the gamification process. It attracts learners and improves their liability to the learning system. Bounces and rewards concept is included as a part of the gamification technique used in the proposed system. Rewards and badges are received by learners not only for their achievements on the academic level, but on other social levels e.g. helping other learners. The course is divided into levels with appropriate alerting for next steps and levels. That turns the learning process to semi-game.



Virtual and Augment Reality

Augment reality is the direct or indirect viewing of augmented objects for the physical environment items, it is created by computer systems based on a sensory system input (e.g. image). Augment reality is included in the proposed system to visualize reality components through 3D objects. It enables users, using some camera system (e.g. mobile camera), to view important objects by focusing the camera on some sort of code for the learnt objects. Augmented reality is also used in creating authoring tools containing a composing tool that can be used to create educational contents, a viewer that plays the content [9].

It is also used with location based systems to view real-time information about different important educational targets. If the subject being learnt is “History”, so, going to the places covered by the course, and using the appropriate client App., it displays important information about that location using augmented reality. It is not restricted to current information, it also shows ancient data and objects on the screen for some place. It also includes a historical slide to show the ancient and current information of that place form historical perspective.

Wearable devices

Wearable devices are clothing and accessories incorporating computer and advanced electronic technologies. The proposed system integrates with some smart devices (e.g. translator headphones), and opens the door for custom integrations with other devices through a rich SDK APIs. Smart glasses, watches, medical devices and others are supported in the system to utilize their portability.



Conclusion

The huge amount of information existing in the world now, and the need to gain as much knowledge as possible by utilizing all the available sensors is the motivation for the proposed system. Learning process has been improved widely to overcome the classical learning techniques limitations. Learning sources nowadays vary a lot from reading a book, to watching an educational video, to play a game, or interact socially with other learners, etc... E-learning exists now in all different life activities through internet, computers, mobile devices and other devices. The need to update existing E-learning environments to cope with human technological rise is urgent.

In this paper we propose a novel E-learning system that maintains existing learning techniques and concepts and adds more technologies to the process to engage learners more with the system. The proposed system tries to conform to daily activities of ordinary human so that knowledge transfer and learning process becomes smoother and more efficient.

The proposed platform is highly customizable to support different learners' needs. It supports learners with different aids needed to simplify knowledge transfer and make the learning process more fun. Gamification, augmented reality and hardware integration are the important features proposed in the system on the user interaction level. Other important features as big data analytics and recommendations are introduced on the reporting level to easily assess and fine tune system performance for learners and introduced courses.



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