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MULTIMEDIA EDUCATIONAL CONTENT IN HOME ENVIRONMENT

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***Abstract**: Children and elderly represent segments for which education is extremely important. It is a known fact that they are major consumers of information, especially from television. New technologies like NetTV will facilitate the distribution of multimedia educational content. In the context of the European ITEA2 Guarantee project, ALTFACTOR is developing a platform that relates the educational content with the information received from sensors. The platform will achieve continuous safety education for children and elderly through cartoon-based animations.*

***Keywords:** education, learning, emotion, home safety*

I. INTRODUCTION

The Guarantee system aims to provide users with a safe living space based on a networked approach involving sensors and actuators local to the user's environment and safety services responsible for decision-making. The system is a set of interconnected devices (stand-alone or networked) that creates a single consistent "safety network". Guarantee's application domain overlaps to some extent with that of Ambient Assisted Living (AAL), which assists people to maintain an independent safety living. Next to this overlap in the application domain, and maybe even more important, Guarantee also shares with AAL the environment it has to operate in, an environment rich of sensors and actuators close to the user such as his home or on-body in combination with online services. The Guarantee general system architecture is presented in Figure 1.

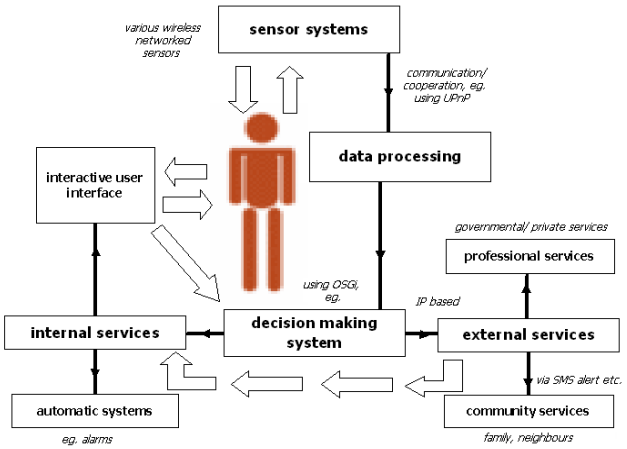

Figure 1. Guarantee general architecture

It is a known fact that children and elderly are major consumers of information, especially from television. New technologies like NetTV and mobile devices will facilitate the presentation of interactive educational materials. In the context of Guarantee project, ALTFACTOR develops a technology that correlates the multimedia educational content with the information received from sensors.

The purpose of the educational animation is to educate the behavior. The system will offer multimedia educational content on specific behaviors: behave properly, socialize, rest frequently, check health, verify the merchandises expiration dates, get medication on time, be organized, do not forget to turn off appliances, etc. A more detailed motivation and market relevance of the approach is to be found in [1].

II. EduNetTV PLATFORM

The EduNetTV platform is a very complex system that includes both internal services and external ones. For internal services, a media-box receives and sends Guarantee specific messages (G-Messages) to and from G-Nodes. For external services, a Portal website is responsible with client's interaction. Between them, a web-based Management Console communicates with media-box and Portal and facilitates to content providers the upload, configuration and generation of multimedia content. The platform overview is presented in the Figure 2. The three main components are:

- Upnp media-box – it is a Home Theater PC next to the TV set
- Management Console (MC) – controls the content delivered to and from the media-box. Also, the management control is the access point for the content producers.
- Portal - it is a marketplace of educational content.

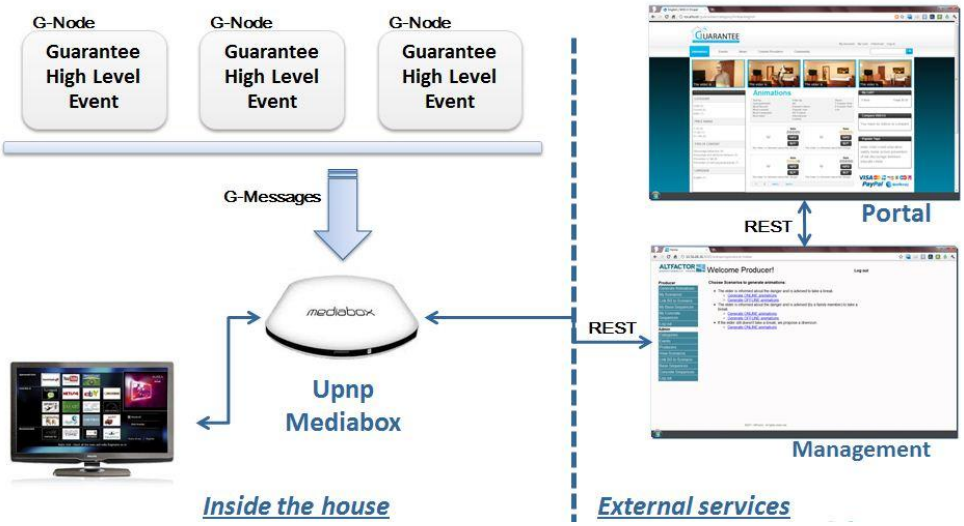

Figure 2. EduNetTV general overview

2.1. Upnp media-box

The mediabox runs on a Home Theater PC, with Windows or Linux. The application will switch the current media flow with the educational content. The events received from Guarantee G-Nodes will be routed to the external Management Console that will decide in real time what educational content will be presented on TV. The URL of the content will be sent back to the media-box. Being an Upnp device, other household items can send commands to the mediabox.

The mediabox architecture is an OSGI based one. This architecture is suitable for future extension with specific modules for communications over XMPP, X10, KNX, RS-232, HTTP etc. The mediabox is conceived as an integral part of a Home Automation Solution. At this time, the media-box supports only Upnp protocol. The following functions are implemented:

- setCommand – the mediabox will execute the received command
- getCommand – information about the current command
- getStatus – information about the mediabox current state

The software is written in Java and C# and the Upnp protocol is implemented using the Cling library. For media playing, it uses the VLC library. The message format sent over Upnp is XML. The following template is used for the messages:

```
<?xml version="1.0" encoding="utf-8" standalone="no"?>
                        <message>
                        <command>
                <category>category_id</category>
                <key>key_id</key>
                <value>value</value>
        </command>
        <command>
                <category>category_id</category>
                <key>key_id</key>
                <value>value</value>
        </command>
</message>
```

The media-box communicates with the Management Console by using the RabbitMQ Bus Messaging System.

2.2. Management Console (MC)

The Management Console (MC) component main goal is to act as an intermediate layer between the Portal (which represents the public interface of the entire system) and the animations that will be generated by a specialized component of the system. The MC provides the means *to setup the cartoons*: what will be displayed, when will be displayed, to whom will be displayed. Of course, the entire structure of the console is *oriented towards the notion of events* and categories of events, since the main aim is to deliver educational content when a certain event happens. For instance, an elderly person stumbles and falls and we have to instruct him/her to choose the right course of action.

To supply a more robust structure to the console, the specific *events are organized into categories*. For example, the event consisting on the falling of an elderly person is associated with the category responsible for preventing the injury of elderly persons. This way it is easier to perform a global logic concerning the animations that make the cartoons that are going to be displayed to the elders. The events and the categories to which they belong are established a priori as required by the Guarantee project and by the actual market for this type of service. Each animation producer may choose to make animation sequences for any of this categories so that the final users can decide (through the Portal component) what cartoons to buy and from which vendor.

An important part of the management of the animations consists in grouping them in *different scenarios for a certain event*. Because the educational animation has an *emotional target* (we need to get the elder's attention in order for the cartoon to be effective), the system will provide different animations for each occurrence of a certain event. The animation that is presented at one time is closely related to the feedback given by the elder (on other related events that occurred in the past or even according to the same event that keeps on repeating itself). Each such different animation depicts an emotional approach resembling a psychological perspective and comes from a scenario defined by the producer. The latter is entitled to deliver a certain default approach as to what emotional strategy to offer to its clients. Of course, this is merely a recommendation: the clients can tune (up to a certain point) this default approach for the best interest of their loved ones.

The architecture of the MC provides a clean approach to the Enterprise Java stack. We chose a productive Java environment that does not make use of hard to develop means as servlets and Enterprise JavaBeans. Instead, Java Play Framework increases development productivity by features that promote it as an ideal instrument for agile software development: hot-reloading of the Java

sources into the JVM, simple stateless MVC architecture, the Request/Response pattern, the REST architectural style, the option for test driven development and the template engine. The modular architecture that gives you the advantage of reusing your own code and/or combining it with other web applications and the great support for asynchronous jobs made it the perfect choice for a rapid and robust solution. Because of the requirements for the creation and deployment of the animation, we chose a Linux based operating system. The Management Console has the following major components:

- Complex Event Processing Unit (CEPU) - will receive High-level Events from media-box and will analyze the events and will generate specific events for the Emotional Inference Engine (EIE). Some events like dangerous situations are also transmitted to Portal, and then to Emergency Services.
- Emotional Inference Engine (EIE) - is responsible for combining several animated sequences into an educational cartoon. The sequences are assembled such as a specific emotional path and target will be accomplished.
- Semantic Repository of Animated Sequences (SRAS) - it will be used to describe the animated sequences and the relations between them
- Animation Rendering Engine (ARE) - will combine the sequences into an educational cartoon (Figure 3). The movie formats will be .mp4 and .flv.
- Delivery and Management System (DMS) - it is oriented toward educational content setup as an internal service: what will be displayed, when it will be displayed, to whom will be displayed.

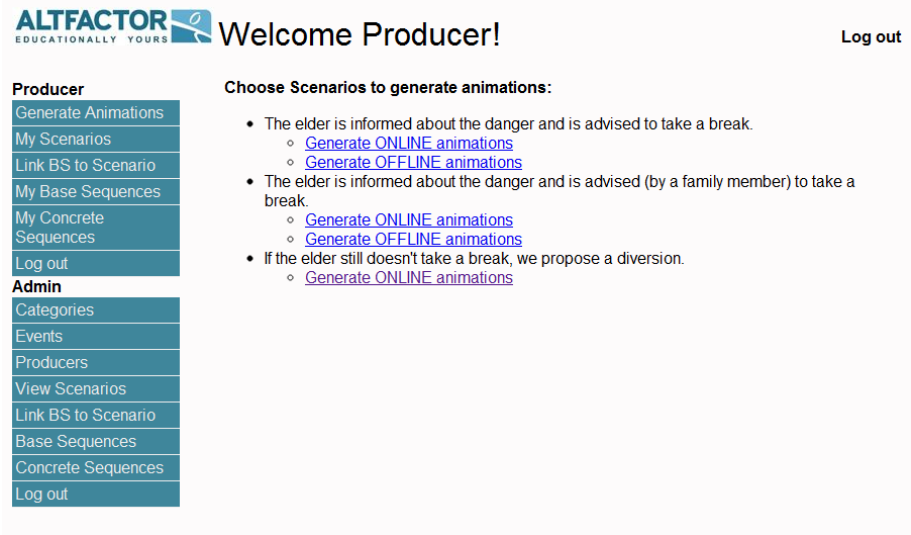

Figure 3. Management Console – Generate animations stage

Our approach to combine the animated sequences into final animations is based on the Hierarchical Task Network (HTN) theory, which is a form of automated planning. In the HTN approach, planning problems are specified by providing a set of primitive and compound tasks. The primitive tasks are similar to the actions in the Standard Research Institute Problem Solver (STRIPS) automated planning language. In STRIPS, for each action we have to specify what conditions must be established (true/false) before the action is executed and what conditions must be established after the action is performed. The compound tasks are tasks that are decomposed into other compound/simple tasks until they are reduced only to simple tasks that are executed in a certain order (absolute/partial order)[2]. The HTN model is more advanced than the STRIPS model and much of this is due to the concept of composed tasks. A composed task can be decomposed by any number of ways. This ways are called methods in HTN and they represent a template by which tasks are broken down.

In our planning of the emotional animations, we take into consideration this major advantage of HTN: the possibility of choosing a course of action or the other (meaning one of the methods) depending on the state of the system. By state of the system we refer to the conditions that are in place

when an event takes place (and an adequate cartoon must be shown): the event itself, the set of animations that one has bought from one/more vendors, the subject's reaction to the repeated event, the specifications made by ones family (through the Portal) – the subject is/isn't influenced by his family members, etc. From such an inference results a HTN representation similar to the one presented below (Figure 4) – one possible approach for the event in which the elder's pulse rises too much from doing chores inside the house.

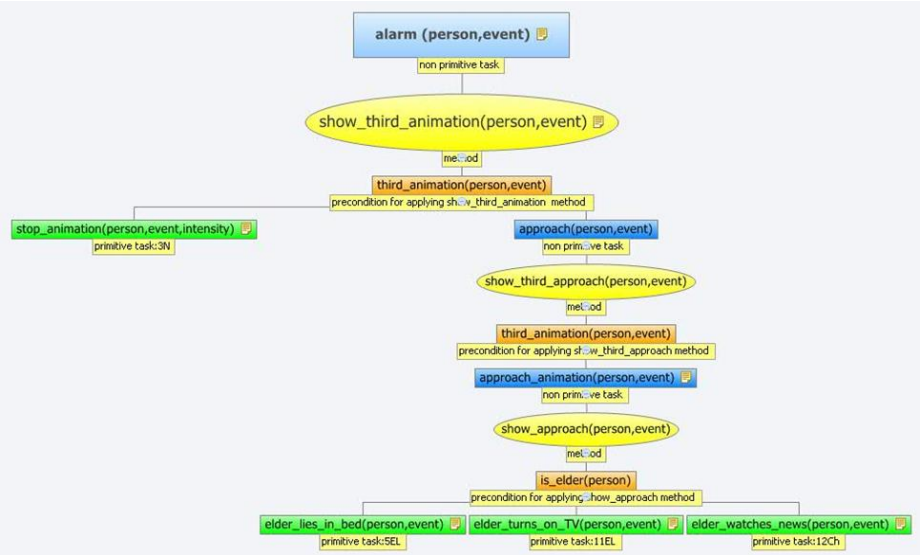

Figure 4. HTN tree example resulting in the animation sequences that make up a final animation

2.3. Portal

The Portal will implement user management features, social networking features and will connect external services such as emergency ones (Figure 5).

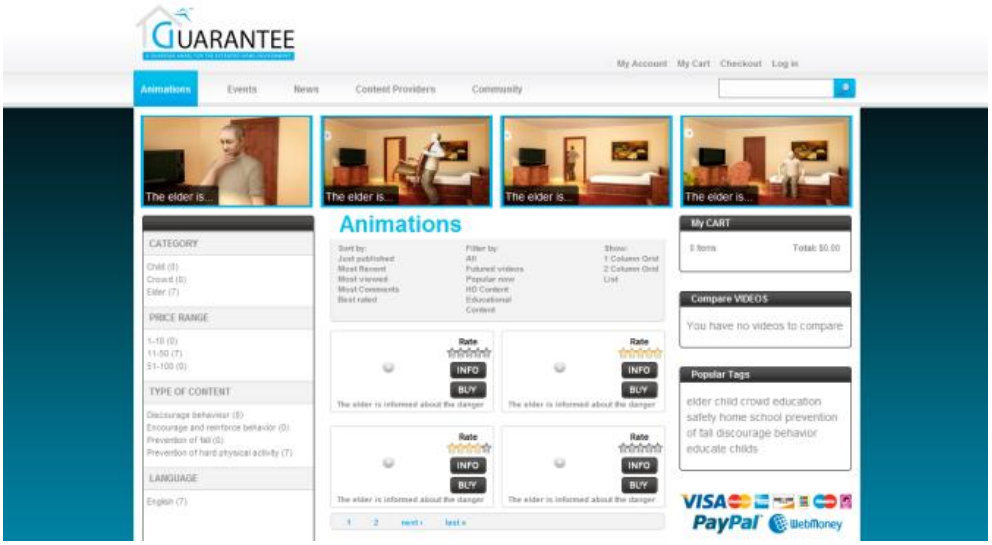

Figure 5. Portal website

The Portal is implemented using the PHP Drupal CMS and has the following main components:

- marketplace of educational content
- community of users, families and relatives
- therapists and specialized institutions
- alerting system for: SMS, Twitter and Facebook

III. CONCLUSIONS

The Guarantee project aims to develop a solution that based on information received from the sensor system, will generate a description of the situation. If these situations are dangerous or potentially dangerous, the system will trigger the default alarms. In addition to these universally accepted dangerous situations, family members may consider many other situations as inappropriate. These situations should not necessarily have a negative connotation. Such situations are difficult to be pre-programmed because it depends on family's education and culture. The EduNetTV platform aims to implement continuous education as a prevention measure of potentially dangerous situations. The platform could be fully integrated into an ambient intelligence scenario: contextual animations presentation, natural integration of animation in the flow of preferred information, capture the actual preferences of parents and family, elements of socialization within the family, friends and relatives, communication with psychologists and specialized institutions.

Acknowledgements

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