# GENERIC IOT AGENT

**Jordan Todorov**

***Abstract.*** *This paper explains the transition of the personal assistants LISSA which operates in a Virtual Education Space (VES) to IoT assistant. VES is as an Internet-of-Things ecosystem consisting of autonomous intelligent components displaying a context-aware behavior. The paper is organized as follows: Section 1 presents a short introduction to the field in question, second part shows a state of the art related works. Part tree briefly describes the VES infrastructure. Section four delves into the students' personal assistant known as LISSA (Learning Intelligent System for Student Assistance) and the changes made to it, in order for LISSA to become an IoT assistant. Part six concludes the paper.*

***Keywords:*** *VES, IoT, intelligent assistant, LISSA*

## Introduction

Nowadays there is a significant growth in interest towards eLearning as many universities develop their own eLearning systems. In line with this trend, a Distributed eLearning Centre (DeLC) project was implemented in the Faculty of Mathematics and Informatics at the University of Plovdiv aiming for the development of an infrastructure for the delivery (or delivering bez the) of electronic education services and teaching content (Stoyanov S., 2005). After years of development, the DeLC project evolved into Virtual Education Space (VES). A serious disadvantage of DeLC was the fact that the virtual environment did not account for the physical world, in which the learning process is performed. Building an infrastructure where the virtual world is integrated in a natural way within the surrounding physical environment would open new opportunities for delivering education services and learning content in a personalized and context-aware way. VES is developed as an Internet-of-Things ecosystem, consisting of autonomous intelligent components, displaying a context-aware behavior (Stoyanov S., 2016). Furthermore, the space is enhanced by approaches using semantic models, mainly in the form of ontologies.

## Related works

Since the notion of using personal assistants for aiding people in their everyday tasks and personal affairs was introduced in the 1990s, there have been many scientific works focused on developing intelligent assistance – one that can replace or greatly aid people in different fields – medical, military, construction etc.

A number of corporate developments are well-known among a broad range of users. Generally, these personal assistants implement user interfaces in a natural language to interact with users. Usually these assistants (such as Siri, Microsoft Cortana, Google Now, LG Voice Mate) are used to support the performance of common everyday activities. For instance, Apple was the first large technological company, which in 2010 integrated the intelligent assistant Siri in its operating system. In its newer versions Siri supports different techniques for self-education. A large group of personal assistants are applicable in the field of healthcare. (e.g. HealthPal (Komninos A., Stamou S, 2006), BeWell (Chen Z., Lin M, 2013), PPCare (Tang Y., Wang S, 2012)).

With the rapid development of technology, a shaping tendency is the increase of traditional educational environments with intelligent components, or the development of educational environments as an integral part of intelligent infrastructures. Some systems which operate as PAs have a new application through promoting instant messaging technologies, which allows the users to select available and accessible online recipients. In the research presented in (Zhang Y., Hu Y, 2014), a platform (type of personal assistant) is developed, which is specialized for students and aids them in their academic and everyday tasks. The personal assistant provides useful interactive functions for control of school curriculum, diaries, finances as well as chat systems.

Another tendency is the introduction of personal assistants in aiding the users' personal mobility. IRMA (Motta G., Sacco D, 2015) makes researches in the field of personal mobility in a possible near-future scenario, which is oriented towards a green, mutual and public transport.

## Virtual Education Space

The Virtual Education Space (VES) is developed as Internet of Things ecosystem with the following characteristics (Valkanov V., Stoyanov S, 2016):

- ***Personalization*** – personal use of resources is supported;
- ***Context-awareness***– the space has the ability to localize and identify changes, which occur in itself;
- ***Distribution and Autonomy*** – the space is comprised of autonomous components;
- ***Smartness*** – the space monitors itself and can make decisions and act towards their execution.

VES is IoT ecosystem and as such the components are grouped in three levels – access level, operative and analytical level and sensory level as shown on Figure 1.

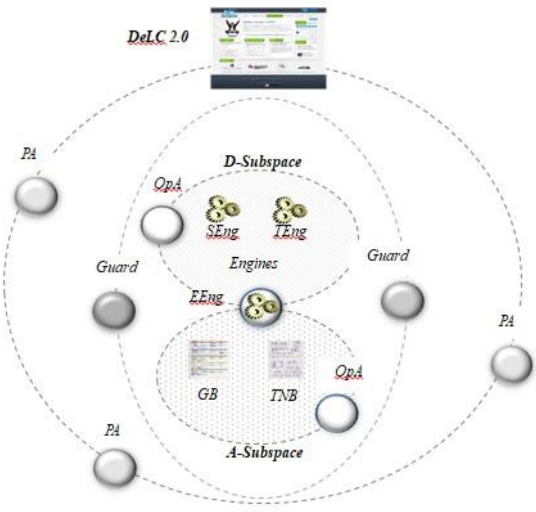


***Figure 1. VES Architecture***

- Access level – Registered users can access VES through personal assistant (PA). For every registered user an instance of PA is generated and the main purpose of the assistant is to aid the student by helping them interact with the space. Non-registered user can only access the space trough the educational portal DelC 2.0 (Stoyanov S, 2010).
- Operative and analytical level (A-Subspace) – This is the most important level of intelligent behavior of the space, the information gathered by the sensor is stored and analyzed there.
- Sensory level – The purpose of the sensory level is to collect and register different types of data, which is used for normal operation of the space. VES has two types

of sensors – virtual sensors and physical sensors. The physical world for the space is represented as collection of physical sensors that are accessible by the guards.

## Lissa

LISSA is composed of several agents (Personal Assistant, Generic Personal Assistant, Generic Dispatcher Agent.

Personal Assistant (PA) – Each user has an instance of PA that is installed on the owner`s mobile device. It is used as an interface to communicate with the rest of the system and with the VES itself. It follows the changes of environment and based on them, warns and gives advices to the student (for example warning for an incoming exam that the student has not yet prepared for). PA also communicates with other parts of the system by messages.

Generic Personal Assistant (GPA) – The main purpose of GPA is to generate user instances of PA for each student. First the GPA interacts with DeLC 2.0 portal to generate the student's profile, after that it generates and initializes the structures presenting the mental states of the PA: Beliefs – the basic events; Desires – student's personal calendar; Once the configuration is completed, the control of the lifecycle is submitted to the new instance of PA.

Generic Dispatcher Assistant (PA) – GDA serves as an interface agent for receiving and transferring messages between PA and GPA, on the one hand, and other assistants in the space (GB, TNB, Guards, et al), on the other hand.

## Transition to IOT

The transition to IOT will give LISSA a lot of benefits. This will give the opportunity to connect LISSA to different sensor networks and will increase the task and the help that can be provided by the assistant. For example if LISSA has access to weather sensors it can predict the condition of the roads and travel time needed for the student to get to university. If it has access to the public transportation networks, it can navigate the user to the closest bus stop and give direction what bus to catch and when to get off of it. One of the most important advantages is the opportunity it provides for helping people with disabilities. For example the assistant can navigate a wheelchair trough the corridors of the university.

LISSA will have access to three main group of sensors – internal sensors, network sensors and guard sensors.

*Guard sensors* will provide alert and information from the sensors with the highest priority, this sensors will warn the user for disasters and the need of evacuating the current location.

*Internal sensors* are the sensors that LISSA has by default. The internal sensors by themselves come into two different groups as well – regular internal sensors and specialized internal sensors.

Regular internal sensors are the sensors that all instances of assistant have (GPS coordinates, time, acceleration etc.) and they are provided by the mobile device that the user already has.

Specialized internal sensors – they depend on the instance of the agent, that is being used and can differ from one another. For example, if the user is mobility impaired, the agent will have access to distance sensors providing information for the distance between the user and different objects surrounding him so the assistance can predict path that can be taken for successful navigation trough corridors. The types of the sensors depend on the assistant profile that is being used.

*Network sensors* – are all the sensor networks that are outside of the normal system. This allows us to use public and other sensor networks that have already been established without the need to build one from scratch. This by itself allows us to easily expand the functionality that our agent offers and even be able to add new functionalities based on the infrastructure of the location that the agent is being used in. In other words, if we use our agent in a big city with metro system and we have access to sensor networks that offer us information of the location and condition of the train cars, we can use this so LISSA can offer accurate information of the transportation within the city.

Thanks to the second specialized internal sensor now each instance of PA can have its own local sensor networks. For example - hearing impaired user will have additional sensor (microphones) for receiving sound waves. This lead us to defining five different user profiles for different situations:

Regular – has access only to the normal device sensor – location, time, acceleration etc. This profile is used by most users and it is oriented towards the regular student.

Mobility impaired profile – this profile has access to additional sensors allowing better pinpointing of the user's location, it also has access to several additional sensor such as a proximity sensor, which can be used to prevent collision with other objects. This profile is oriented toward users that have temporary or permanent mobility problems.

Vision impaired profile – allows access to sensors helping blind people navigate, and at the same time warning them for objects around them and even reading out loud signs for the user. This profile is oriented toward user with temporary or permanent blindness.

Hearing impaired profile – has sensors that identify sound waves around the user and warns them with a gentle tap on their wrist in order to warn them that there is a sound of importance. It also converts speech into text for the user. This profile is oriented towards people with hearing problems.

Mental disability profile – this profile will help users with different mental issues. The profile is currently under development and it is to be defined what kind of sensors are needed to to be able to function properly, according to the needs of users.

## Issues

One of the issues that I had to face during the transition to IOT system was JADEX not supporting OSGI, so I was forced to improvise. The changes can be seen on the following figure.

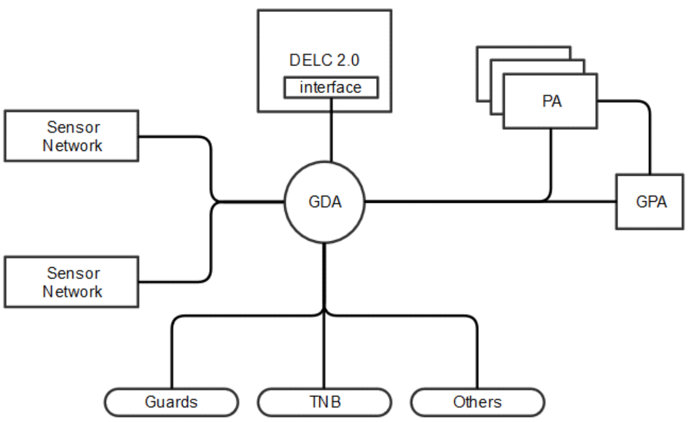


***Figure 2. LISSA Architecture***

The first important change that I made was that now the GDA is now JADE agent instead of JADEX, because JADE supports OSGI & I can use it to communicate easily with the sensor networks. This separation also helps to define the 3 separate groups of sensors that have been mentioned earlier. The GDA receives the information from all of the sensor networks and "decodes" it separating it in different groups "immediate need" and "long term need". The definition of the groups depends strongly on the specific personal assistant instances that are active at the moment of receiving the information and it is strongly individual. For example information for the incoming train may be "immediate need" for one user but it in the same time may be "long term need"" for another. All the immediate information is being sent directly to the instance of the PA that needs it and the rest of the information is send to the GPA which stores the information for future need.

The other task of the GDA is to receive information for emergencies from the guards and take care of delivering all the warnings with priority to the instances of the PA in case of immediate danger. The guards deliver the messages to the GDA instead of PA`s directly because the mail agent is designed to send all the warnings with priority and warn all people in danger faster. In such case the GDA warns not only the devices in danger but also the GPA as a backup plan. In the rare case when the connection between the GDA and PA is interrupted - the connection between the GPA and PA still remains active.

The mail agent also receives messages from other agents from the space and takes care of delivering the information to the instance of PA that needs it in order to function properly.

## Conclusion

In this paper we presented the changes that have been made to LISSA and its transition to IoT. The current prototype which we have described in previous publication, is still at version LISSA 1.0 and we are now working on implementing the changes that we have mentioned in this paper. The two profiles that we are most interested in, are the ones for the mobility and mentally disabled people. We strongly believe that we are on the right path to creating a system that, will be of great help to people in need & will greatly improve their daily lifestyle.

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## ГЕНЕТИЧЕН IOT АГЕНТ

**Йордан Тодоров**

**Резюме:** Статията представя преминаването на LISSA от нормален асистент намиращ се в ВОП пространството до IoT асистент. ВОП е интернет на нещата еко система която се състои от самоуправляващи се интелигентни компоненти. Статията е съдържа следните части: Част първа представя кратко въведение, втората част показва други разработки в същата сфера, третата част кратка разглежда архитектурата на ВОП. Част четири описва LISSA и промените извършени по системата за преминаването им към IoT. Накрая статията завършва с кратко заключение.

***Ключови думи:*** *ВОП, IoT, интелигентент асистент, LISSA*