7 | A SERIOUS GAME IN MIXED REALITY TOWARDS URBAN NETWORK DEVELOPMENT

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The environment we interact with consists almost of the visible side of what our world is made of. Indeed, a lot of things around us are not directly visible. It is especially the case of urban networks like water or electricity supply, telecom, sewer system, etc. All these public services which are crucial for our societies are voluntarily hidden for esthetic or security purposes. Notwithstanding that state of affairs, working in the public domain induces important costs, spends a lot of time and, very often, results in partial or total destruction of existing infrastructures (intentional or not due to digging or drilling).

In this context the way professionals have to be taught is especially difficult and quite inefficient if we want to teach by example. If a teacher wants to teach how to build a new water adduction system, he (or his school) must have the specific tools to dig a hole into a road to a certain depth while taking care of the existing services - and certainly still in use -, to place the new pipes while observing the security measures, backfilling the trench and rebuilding the road. All these phases last a long time and are very expensive. According to the available time and money, this kind of teaching is impossible even for a single student. And what about a whole class?

New technologies as Mixed Reality (MR) and Augmented Reality (AR) can partially figure out these problems as they insert some virtual information seen by the user in the real world. This virtual continuum gives him the ability of watching virtual things which do not exist in the real world or are not visible to the naked eye. Indeed, MR and AR can emphasize real and existing elements which are not visible like urban networks. Besides, manipulating virtual objects allows using video game mechanisms and therefore benefitting from serious gaming advantages. It is proved that Serious Games and specifically Learning Games - Serious Game designed to support learning - enhance the learning process in a professional context [1]. Thus, the teacher can superimpose virtual objects which represent what he wants the student to consider, like construction elements - new or existing - and monitor his actions. Moreover, taking into account the real environment is hugely valuable for teaching because of the richness of information abounding in the real world, and will help the student understand more easily technical concepts [3]. This immersion will force him to face the real world complexity and will help link abstract concepts to reality. On the other hand, the teacher can also define the exercise difficulty if he considers the student progression and filters what is important or not.

For example, if the main aim is teaching how to cope with a new service network design, the student will progress more efficiently if he can focus only on the exercise aim.

Watching virtual things which do not exist in the real world

Hence, the teacher will virtually define the constraints the student has to deal with. Then, the student will learn how to build a new service with only the necessary constraints related to it and aligned with his capabilities. All that work can be done without really constructing it and therefore without digging, destroying existing elements or generating all the costs induced by these works [2].

Designed for teaching, the system developed at the HE-Arc as a Mixed Reality Learning Game (MRLG) manages exercise teacher-given requirements like start and end points, existing services,
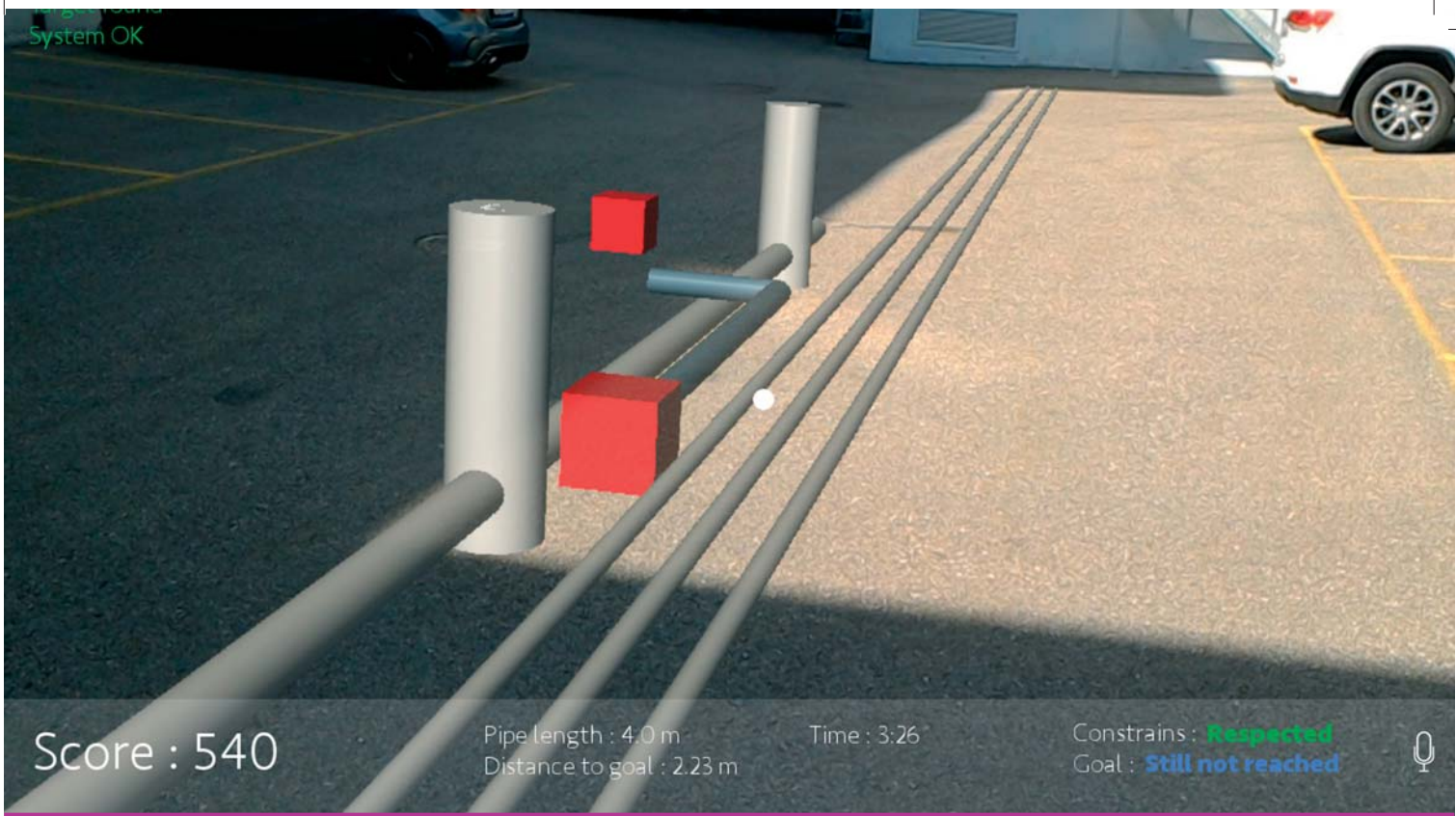
obstacles, mandatory crossing points, etc. The system gives real-time feedback to the student like the old pipes length, if the new pipes stay underneath the ground surface, the time to link the start and end points, etc. The student work results in a virtual 3D model which can be later analysed by the teacher, can be debriefed with the student and will help orienting pedagogy. Teaching becomes more efficient, cheaper and spreadable to a wide number of students because it requires nothing more than a device. Moreover, if necessary, the student can redo the exercises as many times as he wants.

Monitoring the user actions in a real environment like the system is able to do allows training too. Therefore based on these specific skills, the system can be used to improve the knowledge of senior professionals in terms of efficiency or state-of-the-art evolution. Challenging the user with specific scenarios to train specific skills. It is also a powerful tool for new services planning as the system allows comparing several options in real time in terms of cost and feasibility but also complexity and nuisances as the project is directly designed on site. The professional can deal with existing construction not necessarily visible and can take into account some unavailable information on drawings like shop entrances or busy roads for example.

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