











Methodology for Learning Programming Languages Through the Use of Virtual Reality Resources

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Abstract: New technologies are allowing us to have access to new tools, as is the case of Virtual Reality, education is one of the areas where it is being used more frequently; in this sense we present a methodology to make use of Virtual Reality in the teaching process of programming using the LabView programming language, which has a fundamental characteristic, that of proposing two development environments, the first one related to the design of the user interface through the use of virtual instruments and the second one related to the source code through connections of the virtual instruments. As results, the necessary components to implement the methodology are presented, as well as the exploitation and scaling of the methodology.


1 INTRODUCTION


The implementation of Virtual Reality technologies requires the necessary technological infrastructure to be able to be exploited without inconvenience. Among the main necessary components are those related to the connectivity of the devices, including


high-speed wireless networks with a stable signal. For this purpose, it is a common consensus to work with the communication protocols provided by the WIFI-6 network (Auccahuasi, et al. 2021a), (Auccahuasi, et al. 2021b). In using and exploiting Virtual Reality technologies, some works used immersive virtual reality (IVR) in student learning, for which concept


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maps will be used, related to the study of different plants (Lee, Hsu, & Cheng, 2022).

Teaching processes are undergoing great changes, originated by the use of new technologies, as is the case of teaching courses related to different programming languages (Srimadhaven, et al. 2020). The power to bring these techniques to virtual environments where students can experience new ways, such as immersive media through virtual reality (Saab, et al. 2021).

Industry 4.0, has originated new changes in manufacturing and industrial processes, which is complemented in proposing methods to perform simulation processes, using the available technology, in this task virtual reality helps to meet these objectives (Kumar, et al. 2021). One of the areas is related to learning processes to simulate birth processes in order to train health personnel (Yu & Mann, 2021).

We also found works for the teaching of the English language with the intention of improving the level of experimentation in order to improve the teaching and learning processes (Barrett, Pack, & Quaid, 2021). The use of virtual reality leads to propose new ways to improve training processes, as in the case of first aid training (Araiza-Alba, et al. 2021). Complementing the different medical procedures that can be simulated using the techniques described (Fealy, et al. 2019).

In this paper, we will address a methodology to apply the techniques provided by Virtual Reality, through the use of virtual reality glasses models Oculus Quest II, for teaching programming languages, applying to the development environment that provides the LabView programming tool and the INMERSED application, where the benefits are exploited in order to improve the experience of students to understand and understand programming techniques.

2 MATERIALS AND METHODS

The methodology we present is related to the use of virtual reality glasses of the Oculus Quest II model, as well as the use of the INMERSED application and complementing it with the interaction of different mobile devices such as computers and workstations, then, we present the procedures to implement the proposed methodology. According to figure 1.

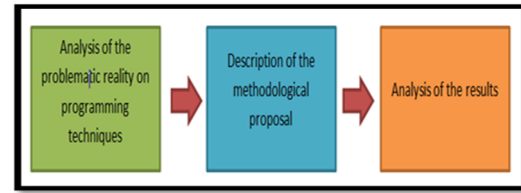


Figure 1: Block diagram of the methodology.

2.1 Analysis of the Problematic Reality on Programming Techniques

Some of the problems that are constantly presented in programming classes, are related to explain and that students can understand the programming logic, which requires a lot of practice by students, and new techniques that allow teachers and instructors can explain the concepts of programming, one of the modern programming tools related to programming and industrial automation, is provided by the development environment LabView, which presents a new concept of programming thanks to the G language, which presents a variation in the way of programming, going from a classic form of programming through lines of code, to a programming based on objects and connections, this form of programming is exploited by two environments, one related to the development of the graphical user interface and is the graphical representation that the user will interact with the system, and the environment related to programming with objects and how they connect with each other, in Figure 2, the development environment of the programming language in LabView is presented.

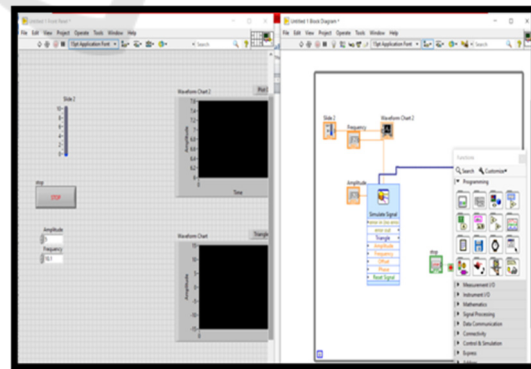


Figure 2: Example of programming with Labview language.

Figure 2 shows the LabView programming language development environment, with the user interface as well as the coding environment. In order

to have a better learning experience, it is recommended that each of the environments is represented on an individual monitor, to be able to understand and exploit the potential of the tool, in a conventional situation the same monitor is shared with the two development environments, which hinders visibility and thus the analysis and understanding of the exercises that are developed in the teaching process.

2.2 Description of the Methodological Proposal

The proposed methodology is based on the use of virtual reality glasses of the Oculus Quest II model, this first component exploits the potential offered by virtual reality, because it allows us to visualize an environment free of any distraction, the experience of using these glasses is the abstraction and thus a greater concentration when viewing your screen, another advantage of the glasses is connectivity through a wireless connection thanks to its WIFI communication protocol, with which the glasses work with a computer connected to a network, where you can share resources. Figure 3 shows a graph of the Oculus Quest II lenses where the connectivity with a computer, the programming language and the user and coding programming interfaces can be seen, the power of the lenses provides all these features at the time of being able to use it as an aid in the learning process of programming languages.

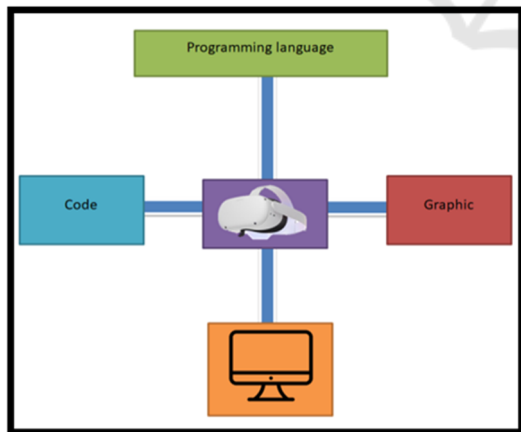


Figure 3: Example of programming.

Another of the necessary components to be able to exploit the VR glasses, is the INMERSED application, with this tool we can interconnect the glasses with the computer or workstation where the application is installed; in order to exploit the

connectivity to the maximum, it is necessary that the computer and the glasses are connected to the same wireless network, so that what can be displayed on the computer can be replicated on the glasses, as well as to exploit all the benefits and profiles provided by the application. One of the advantages is the option to create virtual peripherals inside the glasses, as is the case of monitors, keyboards and other peripherals, the use of multiple monitors help in the learning process because you can customize the different applications and to visualize them inside the glasses, in Figure 4, you can see the connectivity and interaction of the INMERSED application and the different devices; the application also provides an interconnection with mobile devices to be able to share the content, through which you can see on the glasses what is displayed on the computer and on the mobile devices you can see what is displayed on the glasses, so you can experience the virtual environment on mobile devices: to be able to exploit this advantage, it is necessary that the mobile devices are also connected to the same wireless network, as well as being able to run the client of the INMERSED application to share resources.

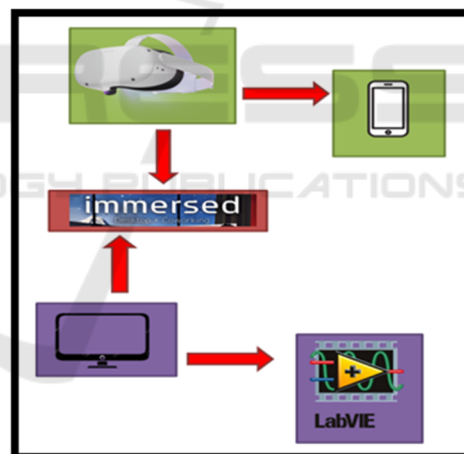


Figure 4: Methodology configuration diagram.

3 RESULTS

The results of the application of the methodology is related to the exploitation of the method and the configuration of the devices, in Figure 5, the final configuration of the INMERSED application with the glasses and the computer can be seen, in it you can see what is observed in the virtual reality glasses, the same thing that is projected on the glasses is projected on mobile devices so the control can be decentralized.

An example of exploitation of the methodology can be seen in a programming class, where there is only 1 lens that the teacher can use to teach their classes, the LabView program is installed on the computer, so the manipulation of the computer is through the glasses, also students can connect to the network and thus can visualize what the teacher is visualizing on the glasses, students can also experience the experience if the cell phones are connected to virtual reality glasses that use with display element to mobile devices.



Figure 5: Methodology Set-Up.

The results we present are related to demonstrate the experience of programming using the programming language G, through the LabView development environment, it is important to note that in order to fully exploit the benefits provided by the Oculus Quest II glasses and the INMERSED application, it is necessary that they are configured on the same network and on all devices connected to the application installed on the computer.

Having configured the components, the experience and the way to exploit the resources provided by the methodology are described, being complicated the capture of what is being visualized in the glasses, the capture of the evidence was done through one of the installed mobile devices.

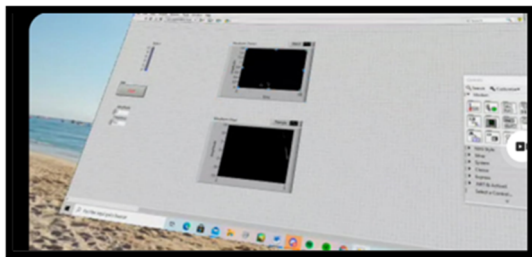


Figure 6: Presentation of the user environment.

Figure 6, shows the environment for the creation of the user interface, it is important to indicate that it can be viewed on a single virtual monitor, also you can see that you are immersed in a beach background

where it can give us a sense of tranquility, what you see is what is displayed in the virtual reality glasses.

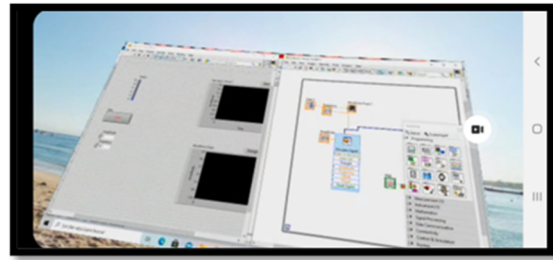


Figure 7: Presentation of user environment and code.

Figure 7 shows the user environment as well as the code environment, each on a virtual monitor, where you can see what is added in the user interface and how it is coded in the coding environment, also both monitors are configured in a sea background.



Figure 8: Configuration of virtual peripherals.

In Figure 8, we present how to add virtual peripherals, where we add a virtual keyboard, with which we can interact in this way, we have a physical keyboard on the computer as a virtual keyboard inside the glasses, with this configuration we increase the interactivity in the management of the technologies that virtual reality provides us, not only to be able to visualize, but also to interact, with which we are reaching a new milestone in the use and exploitation of virtual reality technologies, where we not only use it to visualize, but also to interact and to be able to program in a virtual environment.

4 CONCLUSIONS

The conclusions we reached at the end of the presentation and the description of the methodology, is to increase the interactivity that Virtual Reality allows us, thanks to it we can program in a virtual environment, in the example we present, we use the LabView development environment, being able to

scale to the use of other programming languages such as Python, R and others, always with the same logic, the use of multiple monitors and the use of virtual peripherals.

Thanks to the INMERSED application, we can have access to the computer, we only need that the glasses are connected to the same network as the computer, so we can navigate through the computer applications and be able to observe them on the glasses, with this application we can perform multiple tasks on the glasses, without the need to install the programs on the glasses, so you can also expand the range of visualization to various mobile devices, for this these devices must be connected to the same network.

Finally we can indicate that the methodology is applicable and scalable to other educational processes, in the particular case of engineering careers, programming courses are the most difficult to learn, so it is necessary to resort to new techniques and methods to ensure the understanding and analysis of programming techniques, One of them is the use of Virtual Reality, the method can be improved using other digital media that can be presented when using the LabView language, as is the case of presentation of manuals, video tutorials, among other mechanisms, all of them can be displayed on a virtual monitor, which improves interactivity and the level of abstraction of students.

We can indicate as a way to discuss the results obtained, with the works considered in the introduction, that although most of the works describe uses and applications of simulation models for medical practice and industrial processes mainly, which help to improve skills and improve practice; our results are similar in the processes of learning the LabView programming language, to improve the level of abstraction and perception of the programming logic and help to understand and differentiate the use of the various virtual instruments, which is one of the main features.

REFERENCES

- Auccahuasi, W., Ovalle, C., Bernardo, G., Felipe, M., Pacheco, O., Lovera, D., ... & Ruiz, M. (2021a). Connectivity pattern analysis for virtual simulation design, based on high-performance game analysis.
- Auccahuasi, W., Ovalle, C., Ayvar, Z., Aybar, J., Quispe, R., Lovera, D., ... & Ruiz, M. (2021b). Methodology for the optimization of resources, applied to virtual reality, through the use of WIFI network 6.
- Lee, SW-Y., Hsu, Y.-T. y Cheng, K.-H. (2022). ¿Los estudiantes curiosos aprenden más ciencia en un entorno inmersivo de realidad virtual? Explorando el impacto de los organizadores anticipados y la curiosidad. *Informática y Educación*, 104456. <https://doi.org/10.1016/j.compedu.2022.104456>
- Srimadhaven, T., Chris Junni, A. V., Harshith, N., Jessenth Ebenezer, S., Shabari Girish, S., & Priyaadharshini, M. (2020). Learning analytics: Virtual reality for programming course in higher education. In *Procedia Computer Science* (Vol. 172, pp. 433–437). Elsevier B.V. <https://doi.org/10.1016/j.procs.2020.05.095>
- Saab, M. M., Hegarty, J., Murphy, D., & Landers, M. (2021). Incorporating virtual reality in nurse education: A qualitative study of nursing students' perspectives. *Nurse Education Today*, 105. <https://doi.org/10.1016/j.nedt.2021.105045>
- Kumar, V. V., Carberry, D., Beenfeldt, C., Andersson, M. P., Mansouri, S. S., & Gallucci, F. (2021). Virtual reality in chemical and biochemical engineering education and training. *Education for Chemical Engineers*, 36, 143–153. <https://doi.org/10.1016/j.ece.2021.05.002>
- Yu, M., & Mann, J. S. (2021). Development of Virtual Reality Simulation Program for High-risk Neonatal Infection Control Education. *Clinical Simulation in Nursing*, 50, 19–26. <https://doi.org/10.1016/j.ecns.2020.10.006>
- Barrett, A. J., Pack, A., & Quaid, E. D. (2021). Understanding learners' acceptance of high-immersion virtual reality systems: Insights from confirmatory and exploratory PLS-SEM analyses. *Computers and Education*, 169. <https://doi.org/10.1016/j.compedu.2021.104214>
- Araiza-Alba, P., Keane, T., Matthews, B., Simpson, K., Strugnell, G., Chen, W. S., & Kaufman, J. (2021). The potential of 360-degree virtual reality videos to teach water-safety skills to children. *Computers and Education*, 163. <https://doi.org/10.1016/j.compedu.2020.104096>
- Fealy, S., Jones, D., Hutton, A., Graham, K., McNeill, L., Sweet, L., & Hazelton, M. (2019, August 1). The integration of immersive virtual reality in tertiary nursing and midwifery education: A scoping review. *Nurse Education Today*. Churchill Livingstone. <https://doi.org/10.1016/j.nedt.2019.05.002>