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HOW TO USE SALSAJ SOFTWARE TO PERFORM PHOTOMETRY, ASTROMETRY, IMAGE PROCESSING IN 3D

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ABSTRACT

Nowadays we have different types of dedicated and specialized software with innovative tools such as SalsaJ, which allows us to teach and disseminate astronomy to people with some degree of vision loss, with the aim of getting them to observe and study the different astronomical objects through other senses such as touch. Education is very important and fundamental in order to increase inclusion by focusing the teaching of astronomy on ensuring that visual-impaired children, adolescents and adults have access to quality scientific learning.

RESUMEN

En la actualidad disponemos de diferentes tipos de software dedicado y especializado con herramientas innovadoras, como SalsaJ, que nos permite enseñar y difundir la astronomía a personas con algun grado de pérdida visual, con el objetivo de que observen y estudien los diferentes objetos astronómicos a través de otros sentidos, como el tacto. La educación es muy importante y fundamental para mejorar los procesos de inclusión, al enfocar la enseñanza de la astronomía en lograr que los niños, niñas, adolescentes y adultos con dificultades visuales tengan acceso a un aprendizaje científico de calidad.

Key Words: educational software — tactile models

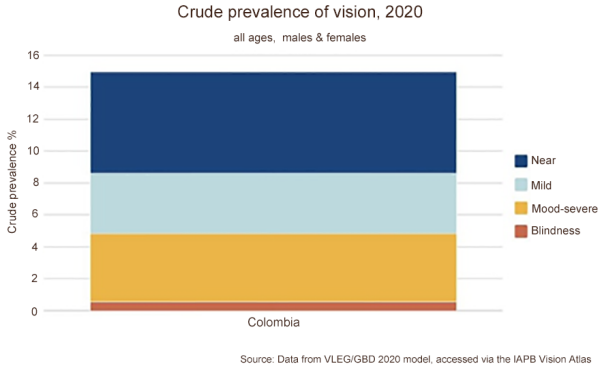

Fig. 1. Crude prevalence of vision, 2020, all ages, males and females.

Fig. 2. Expoastronomy Global Sky Partner LCO Las Cumbres Observatory https://lco.global/education/partners/expo-astronomy/.

1. INTRODUCTION

In 2020 in Colombia, with a population of about 50 million people, there were an estimated of almost 9 million people with vision loss, including ∼300.000 Blind people (IAPB 2022), with an average prevalence of blindness (0.58%), mild visual impairment (6.34%), Near (3.78%) and Severe (4.28%), as shown in Fig. 1.

Visual impairment is defined as visual acuity (VA) less than 20/40 to 20/400 in the better eye, with the best available correction (Dabian et al. 2020). Visual impairment includes low vision as well as blindness (Resnikoff 2004). Also of importance in the definition of blindness is the level of visual acuity that is applied. Visual acuity levels of <20/400 or <20/200 in the better eye have been commonly used to define blindness (Salomao 2009). We carry out training courses for physics teachers, STEM knowledge areas and groups of elementary students, High school and first semesters at university, in several Colombian cities for people with some visual limitation, thanks to the images taken with remote telescopes from the network of robotic telescopes of Las Cumbres (LCO).

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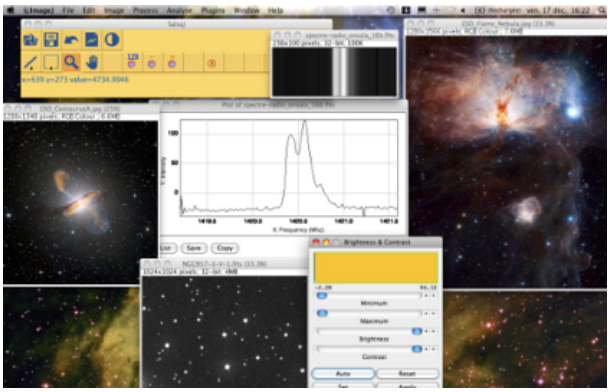

Fig. 3. SalsaJ, Software Menu.

Using data from the Observatory LCO, whose robotic telescopes are located in Australia, Spain, South Africa, Canary Islands, Chile and the United States, the participants of these courses can carry out scientific research using SalsaJ software and its 3D visualization tools, which are appropriate for volumetric printing that allow to use other senses, such as touch.

2. LAS CUMBRES OBSERVATORY (LCO)

We are a Global Sky Partner of Las Cumbres Observatory (LCO) project LCOEPO2021B-008, currently in progress (Fig. 2), which gives us the opportunity to use professional scientific equipment (Global Sky 2022) providing us with telescope hours, which we use to take astronomical images. Scientific data are the main input to carry out our research, courses and workshops to people who normally do not have access to them.

3. SALSAJ SOFTWARE

SalsaJ is a free, student-friendly software developed specifically for the EU-HOU project (SalsaJ 2022). Figure 3) shows some images extracted from SalsaJ. It is designed to be easily installed and used, and provides tools for students and teachers to explore, inquire and analyze real astronomical images, allowing to extract scientific data in the same way that professional astronomers do, producing the same enthusiasm for science that motivates new scientific discoveries.

4. PHOTOMETRY, ASTROMETRY AND IMAGE PROCESSING IN 3D

Our program includes education and training, through tutorials, guides, on the acquisition and recording of images from the robotic telescopes of the LCO network, training in the extraction of scientific data from observations, photometry (Fig. 4),

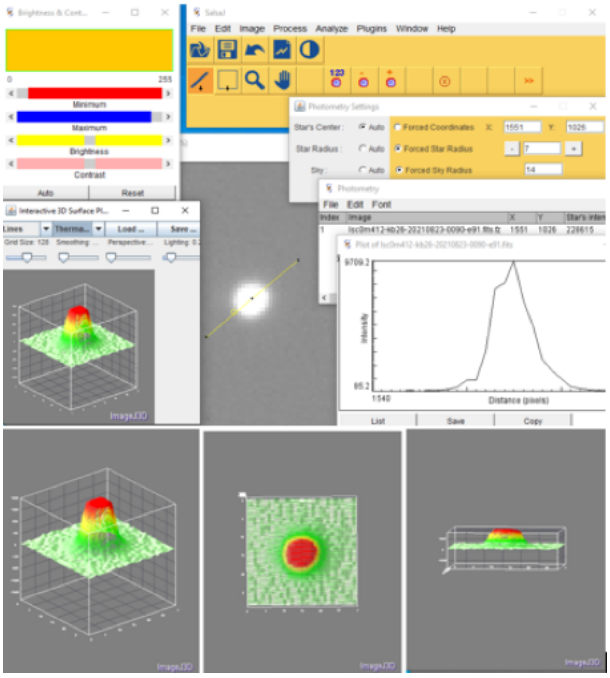

Fig. 4. Photometry in 3D, Estrella Binaria TYC 8409-975-1 Expoastronomy, Las Cumbres Observatory LCO, 0.40 mtrs, Cerro Tololo Observatory.

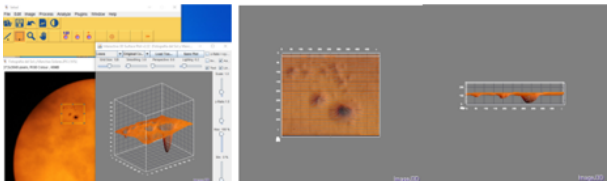

Fig. 5. Astrometry in 3D, Sunspots J. Mora, J. Henao, Celestrón, 0.20 m, Medellín.

astrometry of sunspots (Fig. 5), image processing in 3D (Figs. 6 and 7), 3D image printing (Figs. 8 and 9) and in doing scientific research. Sessions can be done virtually and in person, encouraging the emphasis on pedagogy focused on project-based learning.

We implement a new teaching method using the SalsaJ software, that consists in a set of tools to extract scientific data from astronomical images provided by the LCO, which we are going to be printed out in 3D, in order to be able to teach astronomy to people with visual limitations through of the sense of touch. After visualizing the scientific images in 3D in SalsaJ, we create a base to support the images in Autodesk Inventor (2022) and then print them with Ultimake Cura (2022). Once printed, we provide the students 3D objects that they can manipulate in order to extract information through the sense of touch, motivating them to be involved in interesting

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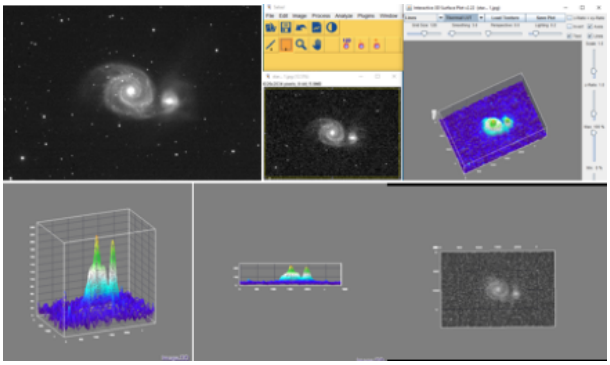

Fig. 6. Image Processing in 3D, Galaxy M51, Expoastronomy, Las Cumbres Observatory LCO, 0.40 m, McDonald Observatory.

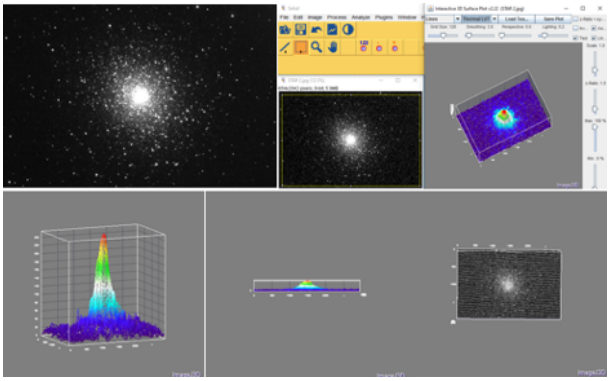

Fig. 7. Printing 3D images, Galaxy M51.

discussions of the different physical appreciation of the objects, representing astronomical data. They are able to explore and analyze the different forms of galaxies, learn from the multiple open and globular star clusters, and much more, in a way that they get stimulated towards deeper research to explain all the astronomical concepts involved.

5. CONCLUSIONS

The 3D astronomical image printing method is an excellent tool for astronomy education and science dissemination for people with visual limitations. We must increase the number of courses, workshops and extend the research for spectroscopic data.

It is important to increase the number of teachers using and managing modern tools for teaching astronomy in the classroom. An astronomy teaching policy should be developed where the inclusion of the vulnerable population that has not been reached with science is a priority. We can strengthen our method by adding terms in braille for the teaching of astronomical concepts.

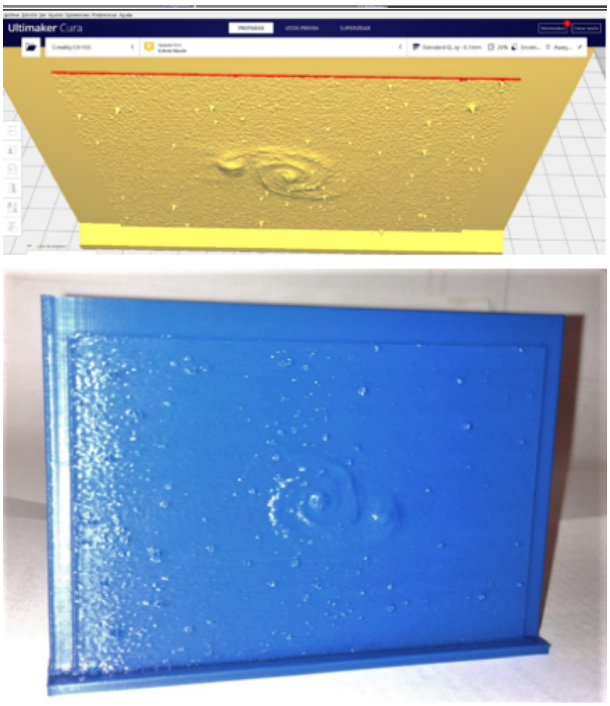

Fig. 8. Image Processing in 3D, Globular Cluster M5, Expoastronomy, Las Cumbres Observatory LCO, 0.40 m, McDonald Observatory.

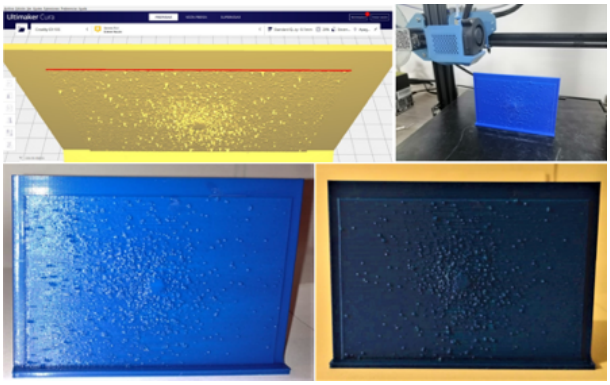

Fig. 9. 3D Imaging, Globular Cluster M5.

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