

## 3D Tactile Moon

Amelia Ortiz-Gil (1)

(1) Astronomical Observatory, University of Valencia, Spain (amelia.ortiz@uv.es)

### Abstract

The 3D tactile Moon was a project funded by the Europlanet Outreach Funding Scheme in 2011. The aim was to build a 3D model that would convey in a tactile way what one sees when looking at the Moon. The 3D tactile model is, therefore, accessible to vision impaired audiences.

### 1. Introduction

The Moon is, together with the Sun, the very first astronomical object that we experience in our life. Since the beginning of history, the Moon has played a central role in human life and culture: agriculture, calendars, poems, pictures, science... But our experience of the Moon is mostly a visual one, and people with sight impairments need to follow a different approach to experience it too.

### 2. A 3D Spherical Moon

There are already a few resources about the Moon that have been designed for the blind, like NASA's "Getting a Feel for Lunar Craters" [1]. And they all have one characteristic in common: they are flat representations of the Moon.

Therefore we set up to create a 3D spherical model of the Moon, with the goal of conveying the visual impression that we have when looking at the Moon. We did not want a mere topographical representation.

We also wished to build the Moon in an easy to share format to make the model available worldwide. For that we chose the electronic 3D format "stl".

### 3 Developing the 3D model

We started from NASA's Clementine visual map of the Moon. Too much detail leads to confusion when you are only touching and not seeing, therefore some deleting and blurring of the image was necessary. Only main accidents in terms of visibility were to be represented, even if they were not relevant topologically,

like crater rays. We kept only large craters, large maria, large mountain ranges and conspicuous crater rays.

We used GIMP as image processing software to increase contrast, blur and delete structures in the original Clementine image. Each important feature can be labeled with a Braille letter. An accompanying document in Braille lets the user know what does each letter stand for. For example, "a" marks the Copernicus crater, "b" marks the Kepler crater, and so on.

Flat caps mark the poles, and the northern one has a sign similar to a capital T to help with the globe orientation.

The resulting processed image file was then converted into an ascii file and fed into the 3D rendering software MeshLab [2].

### 4. The 3D tactile Moon

We printed a prototype of the Moon in a 3D printer in polyamide. Then, a silicone mould from the prototype was used to produce 20 cheaper copies in resin.

The 20 copies were shipped around the world (Argentina, India, Brazil, Puerto Rico, Nepal, ...) to educators and outreach professionals who were carrying out astronomical activities including vision impaired people. They were tested with many different persons from a variety of backgrounds and we got extremely positive comments along with some feedback that led to the final model (Figure 1). It is worth to stress that the model was highly appreciated also by the people with no visual impairments.

### 5. A Touch of the Universe

The success of the 3D tactile Moon made it the seed of the project *A Touch of the Universe* [3], in which we are developing tactile 3D planetary models that have become part of the IAU100 public exhibition *Inspiring Stars* [4]. *A Touch of the Universe* is funded mainly by the IAU Office of Astronomy for Development (OAD).



Figure 1: The 3D tactile Moon for the blind. The northern polar cap has a cross engraved to help with the orientation of the ball. The surface has been largely simplified for the sake of clarity.

In the first release, we built a set of 30 kits to teach astronomy including vision impaired kids where the 3D tactile Moon was a key element (Figure 2).

We have recently developed new tactile models of Venus, Mars and Mercury that can be downloaded for printing from the *A Touch of the Universe* website. This has been possible also thanks to the new software "*Mapelia*" [5] that converts maps into tactile globes.

## 6. Summary and Conclusions

We have developed a 3D tactile model of the Moon accessible to all persons regardless of their visual abilities. It was the seed of a larger project (*A Touch of the Universe*) that is in the process of developing 3D tactile models of terrestrial planets.



Figure 2: The first kit of "A Touch of the Universe", a set of astronomical learning resources that are accessible also to kids with visual impairments.

## Acknowledgements

Many people have helped in the development of these tactile resources. We cannot list them here because of the limited space available but their names can be found at the website of *A Touch of the Universe*. The projects outlined here have been partially funded by the 2011 Europlanet Outreach Funding Scheme and the IAU Office of Astronomy for Development (OAD), with generous support from many other institutions. The author acknowledges financial support from the Spanish Ministry of Economy and Competitiveness under project AYA2016-81065-C2-2.

## References

- [1] Hurd, D.: Getting a Feel for Lunar Craters, NASA, 2011.
- [2] Meshlab: <http://meshlab.sourceforge.net/>, 2011.
- [3] A Touch of the Universe: <https://astrokit.uv.es/>, 2018.
- [4] IAU100: <https://www.iau.org/public/iau100/>, 2018.
- [5] Ortiz-Gil, A., Burguet, J. (2018) Mapelia and friends: create 3D models from maps. *Journal of Open Source Software*, 3(25), 660, <https://doi.org/10.21105/joss.00660>