

# A LIGHT POLLUTION SIMULATOR

Juan Carlos Farah<sup>(1)</sup>, Nuno R. C. Gomes<sup>(2)</sup>, Rosa Doran<sup>(2)</sup>, Denis Gillet<sup>(1)</sup>

<sup>(1)</sup> EPFL – École Polytechnique Fédérale de Lausanne, Switzerland; <sup>(2)</sup> NUCLIO – Núcleo Interativo de Astronomia, São Domingos de Rana, Portugal

juancarlos.farah@epfl.ch, nuno.gomes@nuclio.pt

## Introduction

In the framework of the Dark Skies Rangers project [4, 5] and the GO-GA Horizon 2020 innovation action [1], we have developed a light pollution simulator aimed at demonstrating the impact of artificial light on the observation of the night sky.

The simulator is not intended to be an accurate astronomical tool, but simply to raise awareness of the importance of using efficient illumination systems and preserving the night sky. Thus, it is primarily designed as a resource for education and outreach. It is based on an original idea from the Need-Less website [3], which used to provide a similar simulator developed in Adobe Flash. Since Flash became obsolete in recent years, we decided to develop a similar interactive tool in JavaScript.

## General Description

### Scenery

The simulator illustrates a nocturnal countryside scenery, with a house on one side and a small hill on the other. A dog is sat next to a tree on top of the hill observing the sky through a telescope, while several stars of different brightnesses—as well as the Moon—can be seen in the night sky (Fig. 1).



Figure 1: Default screen of the simulator.

### Configurations

The user is able to place and adjust up to seven exterior lighting fixtures in the pathway that separates the house and the hill. The lamps can have different configurations, depending on the type of shielding and height of the lamp post (Fig. 2).

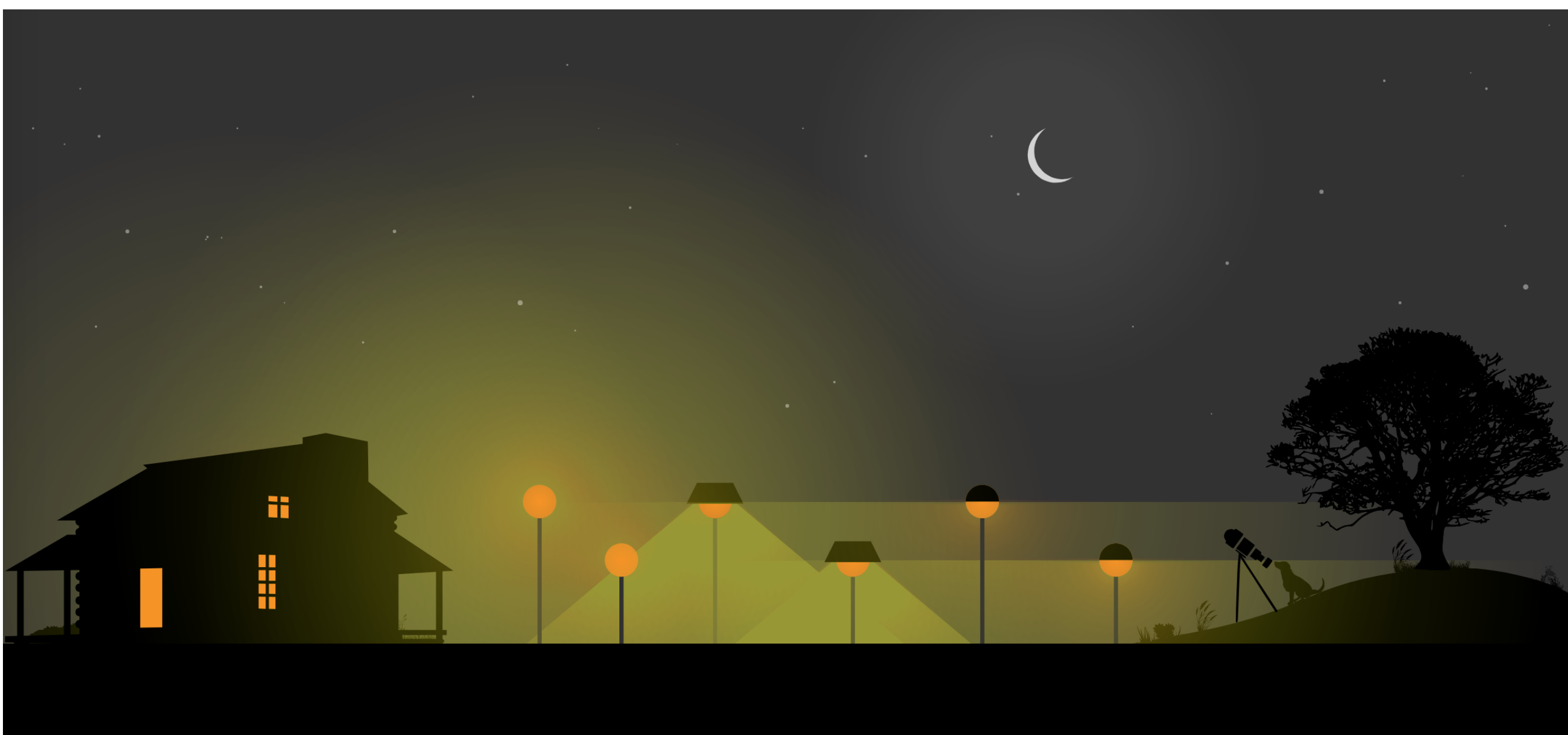


Figure 2: An example with six lamp posts added to the path. Highlighted are the two possible sizes (*tall* and *short*) and the three possible shielding configurations (*no-shielding*, *half-shielding* and *full-shielding*).

Regarding the shielding, the lamp can be (a) unshielded, allowing the light to be sent upwards and hence strongly affecting the visibility of the stars, (b) half-shielded, sending light sideways and downwards, partially affecting the observation of the night sky, or (c) fully-shielded, only allowing light to be sent downwards and thus not affecting the observation of the celestial bodies. There are two possible heights for the lamps, al-

lowing us to demonstrate that in some cases small lamps are enough to illuminate the path.

The Moon can be in a crescent, quarter, full or new phase. Each phase has a different effect on the visibility of the surrounding stars (Fig. 3).

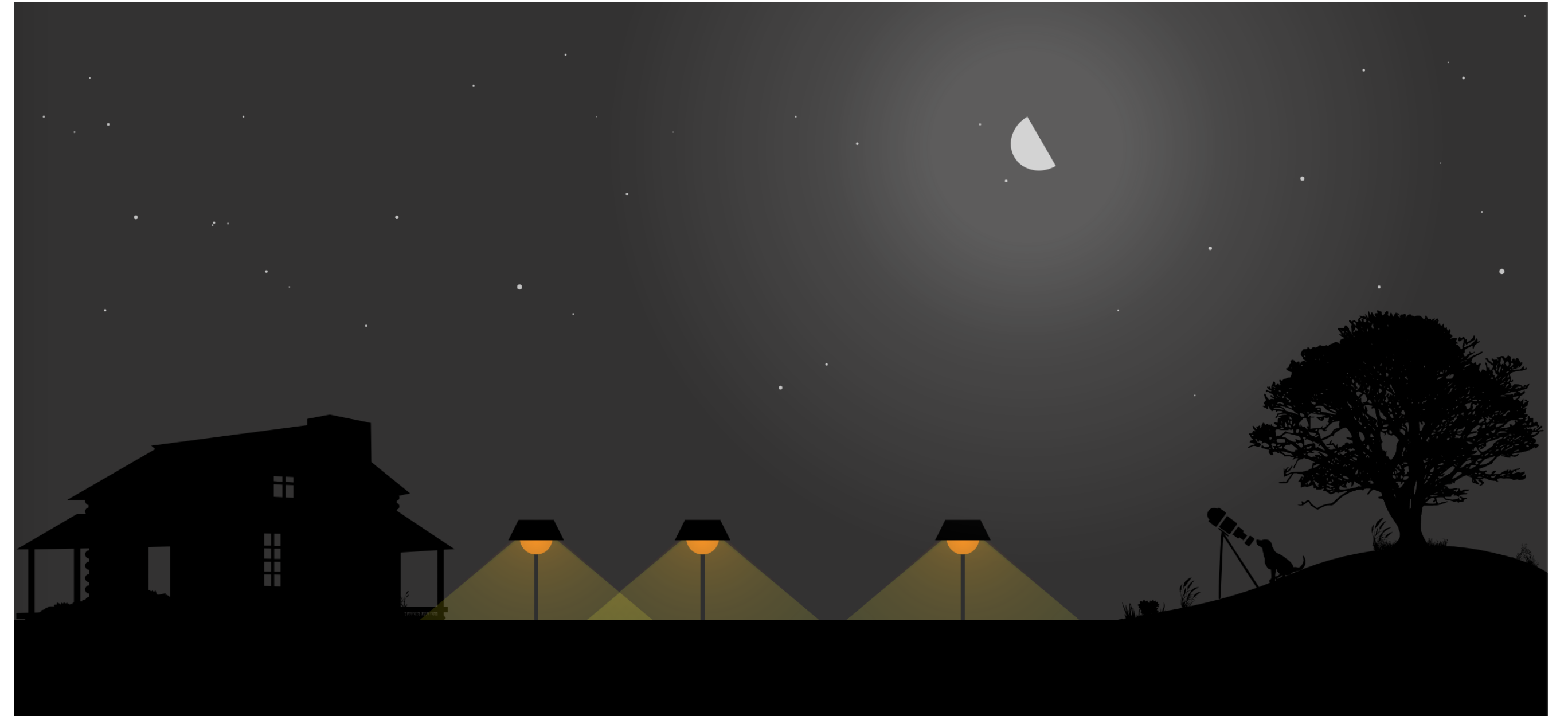


Figure 3: With full shielding, there is almost no light pollution and stargazing is perfectly possible, even if the path is illuminated. However, in this case, the Moon is in its quarter phase, adding moonlight to the sky and thus affecting the observation of the stars (compared to Fig. 1).

Several sounds are automatically reproduced depending on the configuration of the exterior lighting fixtures. If it is dark enough, the user can hear crickets chirping and owls hooting. However, if the scene is too illuminated, then the user will hear birds singing, as if it were dawn.

## Add-Ons

A number of add-ons are being planned and will be implemented in the near future, such as two mini-games and a cost estimator, which will try to draw attention to the waste of energy and the benefits of using intelligent lighting systems.

The first mini-game intends to illustrate the use of intelligent systems of illumination. When all lamps are fully shielded, double-clicking on the observer turns off all the lamps and causes the observer to go home. Lights along the path will turn on as the observer passes below them, only to immediately turn off once the observer has moved on.

In the second game, the user is invited to find a frog that is hiding somewhere in the scenery. This is achieved by placing a lamp in several positions of the pathway while paying attention to the ambient sounds.

Finally, there will be an option to estimate the cost of illuminating the path based on the number of lighting fixtures and the type of lamps used.

## Software

The simulator is currently under development, using JavaScript and React/Redux. It is open source and freely available as a lab for the Graasp [2] digital education platform. It also supports mobile phones and tablets, and is available at [bit.ly/light-pollution-simulator](http://bit.ly/light-pollution-simulator).

## References

- [1] GO-GA Consortium. GO-GA – Go-Lab Goes Africa. [go-ga.org](http://go-ga.org). Accessed on 2019/08/29.
- [2] EPFL. Graasp – A space for everything. [graasp.eu](http://graasp.eu). Accessed on 2019/08/29.
- [3] Need-Less. Interactive simulations that demonstrate the effects of light pollution. [need-less.org.uk](http://need-less.org.uk). Website currently not available.
- [4] NOAO. Dark Skies Rangers. [globeatnight.org/dsr](http://globeatnight.org/dsr). Accessed on 2019/08/29.
- [5] NUCLIO. Dark Skies Rangers Portugal. [dsr.nuclio.pt](http://dsr.nuclio.pt). Accessed on 2019/08/29.