Assessment of Lighting Conditions around Residence Halls of the University of Tsukuba Campus

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1. Motivation

Mayor Michael B. Coleman of Columbus (Ohio) once said: "*Criminals are like roaches, when the lights go on they scatter*". That's why outdoor lighting is considered to be a critical aspect of nighttime safety especially inside a university campus.

2. Purpose

The general purpose of this study is to assess the exterior lighting conditions around the campus dormitories' areas. Specifically to identify areas that could be classified as gloomy and to outline light-polluted areas or in other words excessive light zones, for more energy efficiency.

3. Study Area

Ichinoya, Hirasuna and Oikoshi areas were chosen as the study area which covers a total area of 363769 m^2.

4. Methodology

The methodology shown in Fig.1 was followed. First, the entire study area was walked with a GPS to locate the different lighting panels. In addition to the location other information was collected: Type (e.g. Solar-powered panel), height (high, medium, low) and lighting color, a total of 280 lamps were found. The second step consisted of extracting each lamp lighting radius by using a python module in order to speed up the process. The last step of the analysis was running a model developed using ESRI's ArcMap ModelBuilder that takes as input the layers of 'Lamps', 'Residence areas' and 'Buildings' and as output 'Gloomy areas' and 'Illuminated areas'.
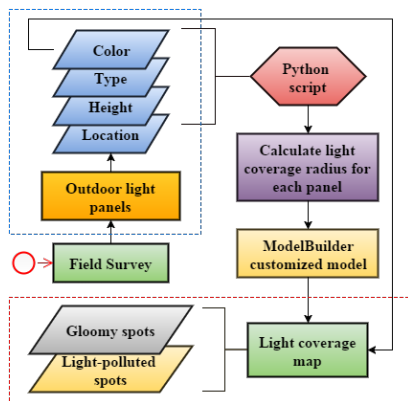
5. Results and Discussion

Fig.2 shows the illumination map of the study area, and highlights the lightest and the gloomy areas. We defined three illumination intensity classes (average, good and excessive) depending on how many light panels coverage zones overlap. Chart.1 shows the area percentage of lighting conditions for each dormitory area.

Generally speaking, the three main dormitories areas enjoy good and balanced lighting conditions. Approximately 55% of the total study area enjoys an average lighting (generally walkways). Good illumination spots are generally consisting of parking lots covering about 8% (areas a.1, a.2 and a.3). Excessive lighting spots are nearly nonexistent (only 1%) except for the focus zone c. in Oikoshi which consists of the area around the nurses' residence halls and this is due to the nature of their job that requires commuting during nighttime to the nearby University of Tsukuba hospital. Gloomy or dark areas (36%) are concentrated mainly in the forest-like areas. However, we've identified some gloomy pathways (areas b.1 and b.2) and areas surrounding buildings (area b.3).

In this study, only outdoor lights panels were considered. However, much of the campus is also lit by building mounted lamps. Furthermore, this study does not include trees. Therefore, when interpreting the map, readers can expect that areas near buildings are actually brighter than portrayed, while other areas may be darker.

It's worth mentioning that illumination color differs. From the resulting map we can see that blue-colored light panels are scattered along the common paths that students usually take when going back to their rooms. As a possible explanation, some medical studies suggest that blue light is an effective antidepressant.
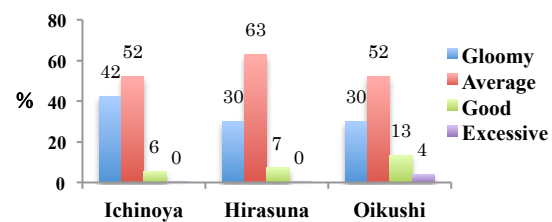

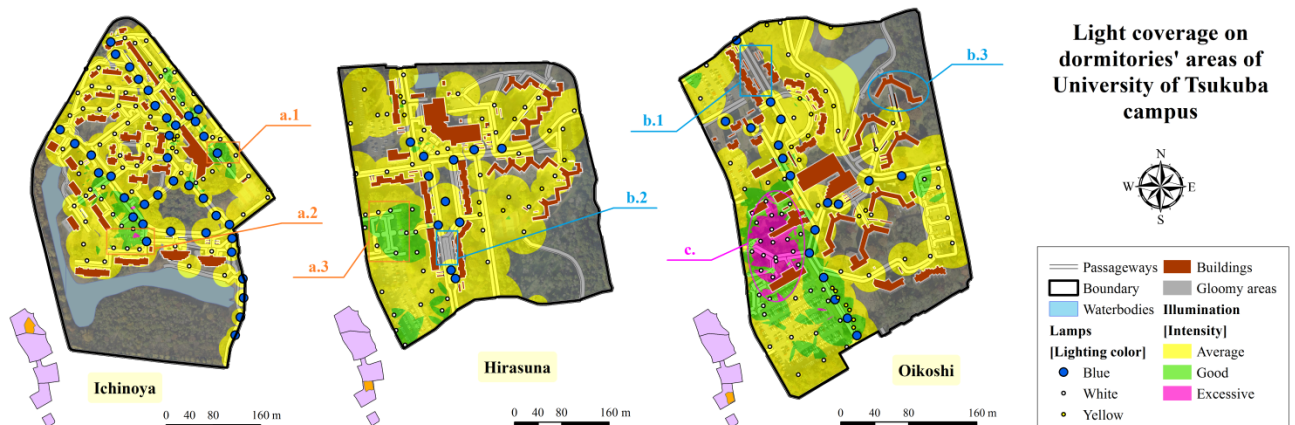**Fig.1:** Methodology of the study

Chart.1: Lighting area percentage for each dormitory area

Fig.2: Illumination map of the study area