A Graphical Unit Interface to Generate Light Distribution Curves

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INTRODUCTION

The necessity of illumination sources, satisfying specific requirements, especially considering low power consumption has produce the continuous appearing of new illumination sources in the market. To characterize them, it is necessary to account with several technological tools, such as luminous flux meters, intensity of illumination meters, goniophotometers and software developed to visualize the luminous intensity distribution. Mathematical approaches to calculate the photometric quantities are also needed.

In the development of goniophotometers (Muñoz, et al., 2013) and in the experimental tests to guarantee their reliability (Sametoglu, 2008), several factors must be considered. Calibration is one of the critical aspects that support reliable operation of illuminance and luminance meters (Fiorentin & Scroccaro, 2010). The automation and implementation cost are also decisive (Cruz-Colon et al., 2012), especially for prototypes development.

In the case of Light Emitting Diodes (LED) sources, the orientation effect is not presented because their emission is independent of their orientation meters (Fiorentin & Scroccaro, 2008). LEDs are lambertian sources. In the case of LED tubes, the luminous intensity patterns of most sources analyzed in (Ryckaert, 2012) are approximately lambertian.

A Lambertian source is defined as one in which the brightness (or luminance) is independent of angle, in other words the off-axis luminance is the same as on-axis. Such a source has intensity vs. angle profile that falls off as the cosine of the angle. Historically, many LED sources have had nearly Lambertian beam distributions, simplifying certain calculations (Osram, 2011).

The photometry, produced by the corresponding photometric report of the luminary is widely used by the luminaries' manufacturers and they are involved in the design process or special applications. The distribution curves of the illumination intensity are also called candlepower distribution curves. Mexican software has also been developed in order to generate these reports for interior lightening (SIMCLI Software, 2012), (García Flores, 2005), but about hardware to measure the illumination level; the information is not so wide. In Colombia, the software LUMENES has been developed to illustrate that the selection of the adequate illumination source depends of several factors such as physical, economical, etc.) (Informe Ejecutivo, 2008)

In (Fiorentin& Scroccaro, 2008), a goniometer installed in the Photometric Laboratory of the Padova University is described and used to realize measurements of luminous flux.

At commercial level, different types of meters have been developed to provide an empirical base of information for specific characteristics, such as: photometers and portables intensity light meters.

In this article, the design of each block of the complete adjustable and automated system prototype of irradiance meter, where the use of programming and software design are fundamental. The improved semi-spherical prototype is developed on the base of a single Photodiode for Visible Light BS520 with spectral sensitivity characteristics akin to that of human eye, which was obtained from a photocopier, inside the package AE (Automatic Exposure) sensor.

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The development of a Graphical User Interface (GUI) is presented. The advantage of this GUI is given by its capability to connect at irradiance meter or goniophotometers to receive the produced data and to generate the light distribution curves without the use of additional graphical software.

BACKGROUND

In the discrete profiles analyzed in (Gonzalez-Roman et al., 2006), the following fact is considered, according to the Pointing vector physics, the irradiance is proportional to the voltage intensity detected in each sensor of the meter. These voltage values allow obtaining the corresponding profile to each source giving the capability to choice of the more adequate sources for specifics tasks. Other approximation was developed in (Tecpoyotl-Torres et al., 2011), where a semi-spherical meter was implemented to characterize divergent sources. In the case of non-divergent sources, a rectangular meter was also developed (Escobedo-Alatorre et al., 2009). In the last two cases, a single photodetector OPT301 was used.

MAIN FOCUS OF THE ARTICLE

This work is focused on the development of a complete irradiance meter, where computer aided design is determinant in the development of the mechanical support, using Autodesk Inventor Student Version.

The programming of the automation stage is also of interest. The selection of the programming type is determinant in the total cost of the meter. In this case, the PIC16F877A microcontroller use was chosen instead of commercial software for systems development.

Finally, the GUI constitutes a very important stage, because its design allows to receive data directly from the meter and to display the graphs of the illumination source under tests. The data can be saved in a file, using the same GUI or other software; the corresponding graph can be generated.

Automation requirements were determined by the characteristics of the mechanical structure. Then, it is necessary to know them.

DESIGN OF THE MECHANICAL SUPPORT

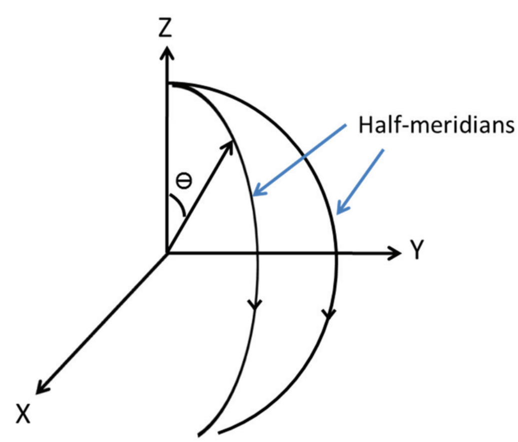
The structural support of the meter was implemented using light material in order to reduce the servomotors' efforts and to provide a more aesthetic appearance. Some electronic parts continues been of recycled material. The mobile rectangle is used as a photodetector support. The main advantage over the instead of a single arm, is the bigger strength provided to the top part of the structure. The aluminum structural parts of the meter reduce the weight of the completed structure in a 66% compared with the previous development (Vera-Dimas et al., 2012).

The half-meridian trajectories required to realize the measurements are produced by the movements of two servomotors (Figure 1). One of them is located on a the lateral sides of the arc, making it a mobile arc, with the optical sensor located at the middle top part, the other one, at the base of the lamp; locate at the center of the meter. The lateral motor produces increments $\Delta\theta = 0.5°$ from Z axis, since 0° up to 160°. After each half-meridian is described, the arc returns to its original position, and the servomotors under the lamp base produces a displacement ($\Delta\phi$) from the X-axis of 45°.

Detector measurements are sent to microcontroller, and after to the computer, to be displayed by the GUI.

Elements added to increase the measurement precision are:

Figure 1. Half-meridians generation ($0 \leq \theta \leq 170°$)



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