Smart Energy Management in a Beer Factory

Beer Factory

The current use case was implemented through a collaboration of the CTI team from IoT Lab with an industrial partner. The partner is a beer industry which ranks as the third largest brewer in the world, based on volume production. The premises where the use case was conducted belong to the largest Beer Factory in the Balkan Area.

A scenario for efficient smart energy management

In order to demonstrate the capabilities offered by the IoT Lab platform, we developed a smart energy management scenario in industrial environment. In this scenario the system tries to optimize the operation of indoor light units that consume energy in terms of energy efficiency. The light units are controlled by actuators that are also resources in the IoT Lab platform. They are dynamically adjusted based on the ambient lighting conditions. Two dedicated sensors are providing input to the system regarding the ambient conditions.

The use case was successfully tested by the cooperation of the Factory Manager and CTI's Engineering team of IoT Lab. The Factory Manager discovered the devices in the IoT Lab platform via the use of the project code and registered the lights and sensors. He also discovered and registered the sensors responsible for the monitoring and actuation of the building. He ran two scenaria, one manual and one automated, with the purpose of comparing the total energy consumption in each, and consequently measure the effectiveness of the IoT Lab platform. During the manual scenario, the building was being ran without the assistance of IoT Lab (the workers were switching on and off the lights manually) and during the automated scenario, the lights were adjusted automatically.

Experimental Setup

The industrial area in which the experiment took place was part of the storing cellars and more specifically the entrance hall, a tank area ahead and the corridor from the entrance to the following tanks and storage areas. The areas were monitored by two sensing motes and controlled by an actuator. The sensors were responsible for recording the ambient conditions (temperature, humidity, luminance) of the tank area and the actuator was in charge of controlling the light switch of the pathway. Additionally, there was a luminance sensor covering the entrance hall and mostly the pathway in order to record the light levels in the controlled area. An energy meter was also placed on the circuit board and measured the KWh the lamp was using. The system ran for 6 days covering two running modes: manual and automated. In the first the employees had the ability to control the light switch of the pathway and in the second a scenario uploaded on the platform took the lead. All the readings (room temperature, humidity and luminance, corridor luminance, lamp state) where polled every 10 minutes. During the automated scenario, the lights were switched on or off depending on the room luminance. Before executing the scenaria, we did a pre-run in order to get some information about how the room luminance alternates in relation with the corridor. This way, we were able to set satisfactory levels of luminance values inside the scenario.

Evaluation of results

Luminance levels. The luminance levels, measured in the two areas, during the automatic and manual scenaria are presented in Figure 1 andFigure 2 respectively. In both cases, there is a room luminance pattern which repeats throughout the test (green line). The shape of each curve is quite identical and the amplitude indicates the climate changes (cloudy weather) during the experiment. There are two peaks: one occuring during the morning hours and one during the afternoon ones. This is explained if we consider the geographical orientation of the building and the windows near the area where the sensors are deployed. The peaks stand for the times, when the sun was rising (setting) and was lined with the level of the windows. If we focus on the corridor luminosity the following are worth mentioning. As seen by our experience in the building as well as in the experiment, many lights were left on, even when no worker was on site. The manual run did not make a difference since we can see the lights being switched on throughout the day. However, when executing the automated scenario we see that lights go off during the daylight hours thus saving energy without leaving the place dark. Note that, members of the CTI Engineering team were testing the minimum luminance levels required for safe walking and clear distinction of the highlighted paths in the hallway (red line). It is clear that the automated scenario, achieves lower luminosity in the corridor (black line), thus lower consumption, but at the same time does not violate the minimum safety luminance levels required by the industry.

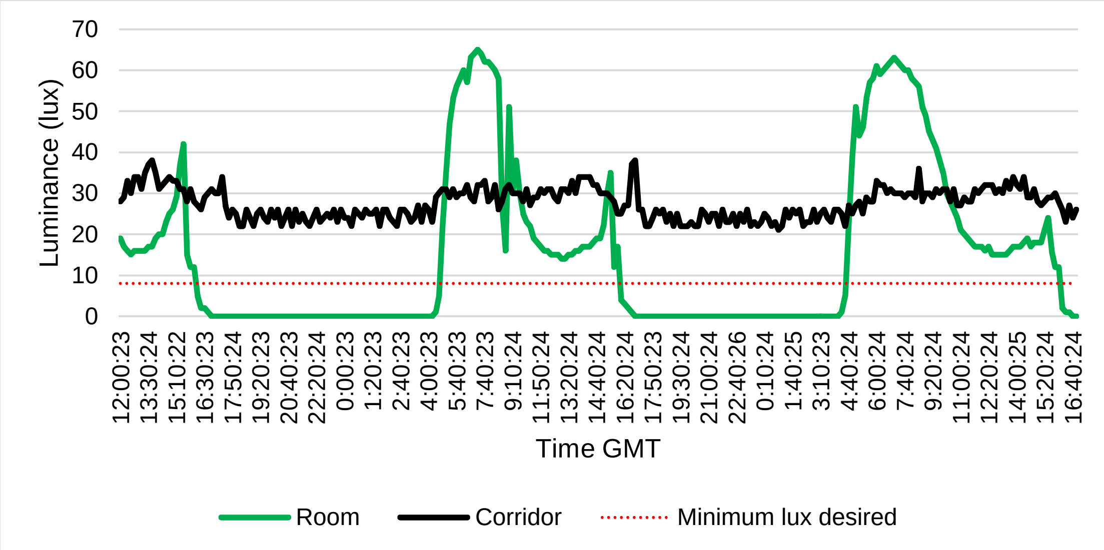

Figure 1: Luminance levels during the manual scenario.

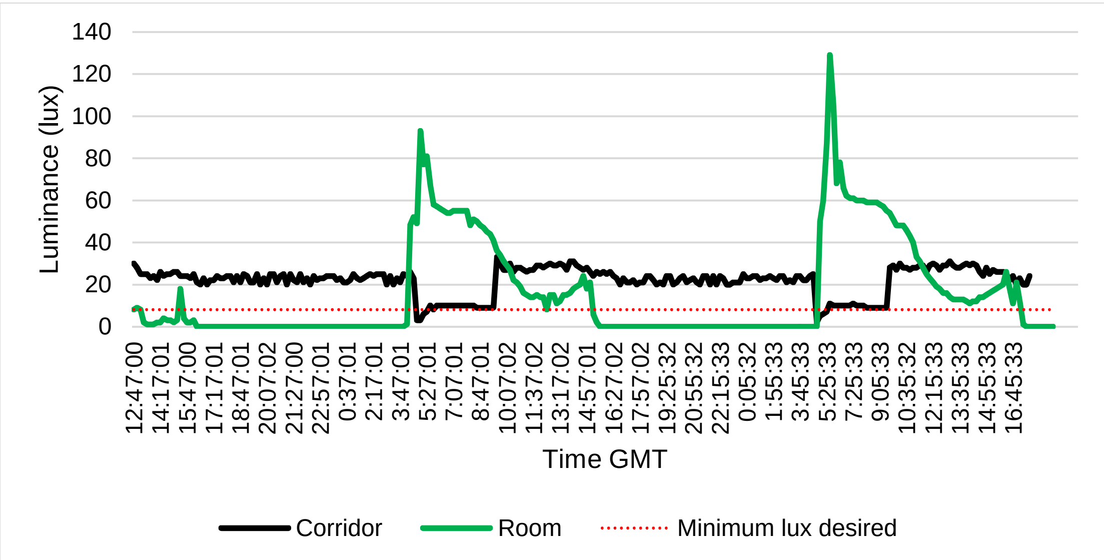

Figure 2: Luminance levels during the automated scenario.

Energy consumption. Energy Consumption measures the total energy spent by the lights. Figure 3 shows the energy consumption for the manual and automated use of the premises for 4 days. The consumption is indicated in groups according to the consumptions of each specific day. The automated scenario through the IoT Lab platform performed much better in all days saving 18% of energy in total, as shown in Figure 4. An interesting remark is that during the manual scenario the lights were open all the time, during all the days. This is due to the workers' behavioral pattern of leaving the lights open when leaving.

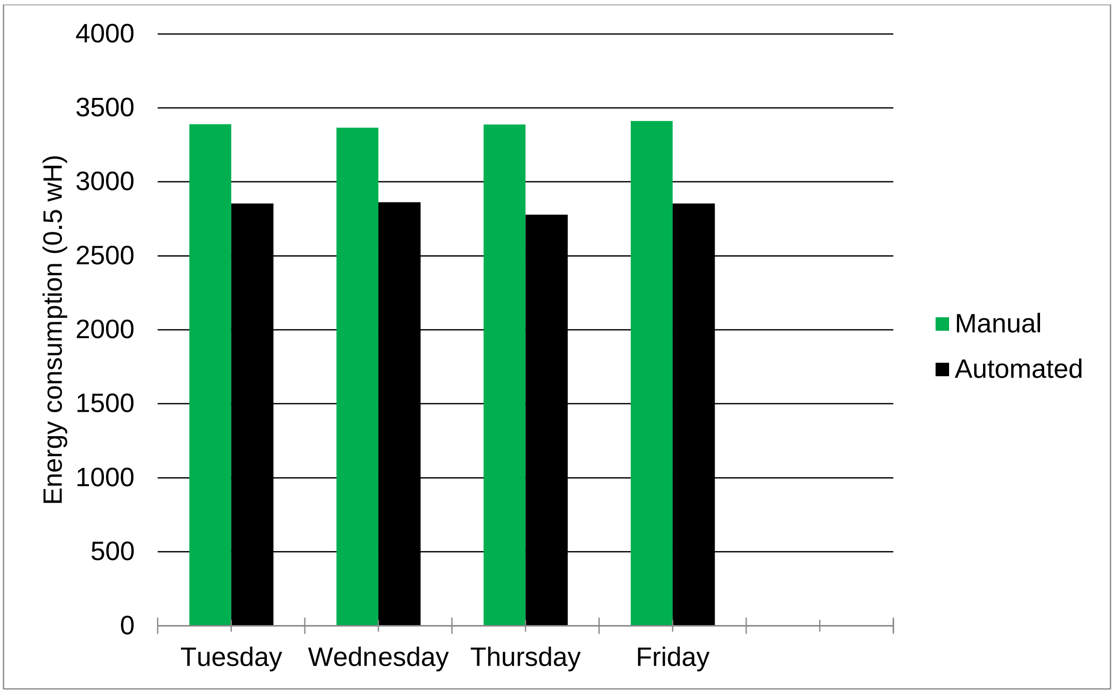

Figure 3: Total energy consumption per day.

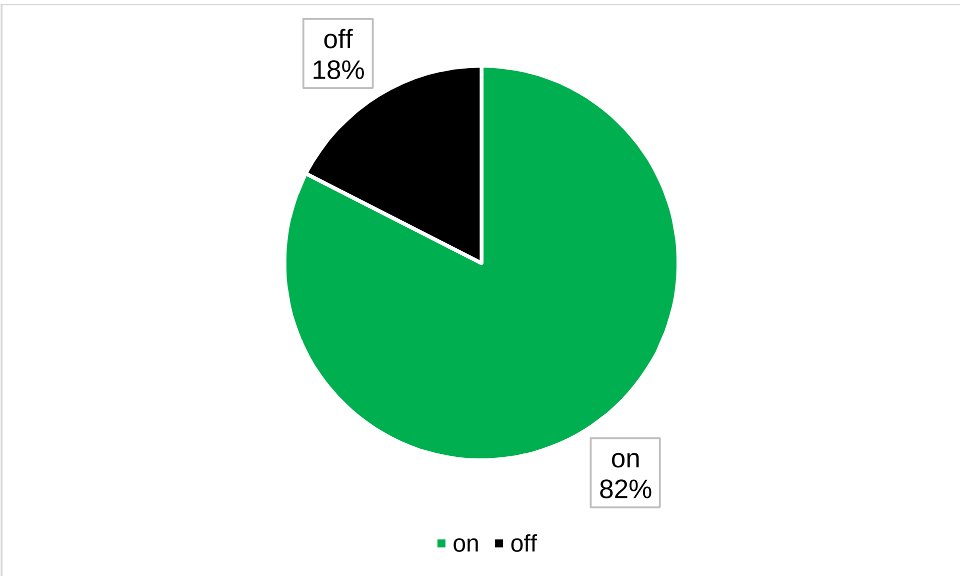

Figure 4: Total energy savings. This pie chart represents the automated scenario. At the manual scenario, the lights were 100% of the time open.