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Automated system for electrical lighting control of a sports field

Sistema automatizado para el control de iluminación eléctrica de un campo deportivo

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Abstract

The illumination gives sport facilities in the local means, at the moment they lack he/she gives a good level he/she gives illumination like likewise give an effective control he/she gives the time he/she gives demanded illumination, these inconveniences and other they take us to innovate the systems he/she gives illumination he/she gives sport facilities and other dedicated facilities to the entertainment I publish where require he/she gives a system he/she gives control for this installation, either illumination, air conditioning, lights give emergency, it alarms against fires, etc., these problems can be solved by the automation by means of PLC (programmable logical controller).

Automated system, Electric lighting, Control, Athletic field

Resumen

La iluminación de instalaciones deportivas en el medio local, actualmente carecen de un buen nivel de iluminación como así también de un control eficaz del tiempo de iluminación demandado, estos inconvenientes y otros nos llevan a innovar los sistemas de iluminación de instalaciones deportivas y otras instalaciones dedicadas al entretenimiento publico en donde requieren de un sistema de control para dicha instalación, ya sea iluminación, aire acondicionado, luces de emergencia, alarma contra incendios, etcétera, estos problemas pueden ser solucionados por la automatización mediante PLC (controlador lógico programable).

Sistema automatizado, Iluminación eléctrica, Control, Campo deportivo

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Introduction

When a lighting control project is carried out for a sports facility, the programme of needs of the facility must be considered. In general, in sports facilities that have already been built, the first thing to consider is the lack of a lighting control system for turning on and off these sports facilities, once they are rented, and on many occasions, it is also possible to note the non-existence of a circuit plan. In general, therefore, all sports centres and sports grounds in the city of Sucre, both private and public, control their electrical lighting manually.

This is why it should be taken into account that players, technical teams, spectators and audiovisual media need to be able to see precisely everything that is happening on the playing field in order to act correctly, as do the spectators, who need to be able to clearly appreciate the circumstances in which the game is taking place within a comfortable lighting environment, They must therefore be able to clearly see everything that is happening not only on the playing field or pitch but also in the immediate vicinity and surroundings, i.e. the lighting must also guide the spectators so that they can enter, leave and take their seats in complete safety; since spectator safety is one of the most important aspects of sports lighting.

The audiovisual media that cover the information of everything that happens in sports facilities also have specific requirements that must be verified to ensure the quality of the image in terms of colour reproduction, textures, i.e. the good quality of the images must be ensured both in the general shots and in the close-ups of players, referees and spectators.

In general, in the lighting of sports facilities, the following levels of lighting can be distinguished: recreational level (training, non-competitive activities and national competitions) and professional level (professional training, national and international competitions with the intervention of audio-visual media). It is in this sense that the present research project deals with the design and construction of an automated system for the control of electric lighting in a sports field and also that this system can also be applied to other spaces in public or private sports fields, or educational institutions to control the switching on and off of lighting in their environments (classrooms, laboratories, etc.).

Problem statement

Due to the student growth that in recent times has occurred in the city of Sucre, both at primary, secondary and even more at university level, is that it has seen the creation of different areas or public and private sports spaces.

A determining factor that sometimes makes it difficult to provide a good service to people who request the rental of these sports centres or spaces is that there is no control of the excess of time used by the players, which results in an excessive use of electric lighting.

This is due to the fact that there is no automatic control, as it is done manually, i.e. the person in charge has to remind people verbally telling them it is time, which can cause inconvenience for those who are playing and who have to leave immediately, but there is also inconvenience for those who are waiting to enter, as they have to wait until it is unoccupied, which causes certain inconveniences and difficulties among the applicants.

Therefore, the problem that has arisen is:

The non-existence of an automated system for the electrical lighting control of a sports field.

Objectives

General objective

To design an automated system for the electrical lighting control of a sports field.

Specific objectives

- Characterisation of electrical lighting systems for sports fields.
- Characterisation of sports fields in the city of Sucre.
- Describe the operation of the system.
- To build the system
- Tests of application to other spaces.

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Importance or justification

The research is necessary in view of the fact that there is currently no automated system for the automatic control of the electric lighting of the different sports fields.

On the other hand, it is considered that this project could not only be applied or executed to a sports field, but that the assembly of the electrical circuit and its operation could be applied to any sports space, in classrooms, computer laboratories or other environments of the academic units of San Francisco Xavier de Chuquisaca, or otherwise also to private homes among others; with which it would be possible to obtain a reuse of the model to be used in different spaces.

With regard to the economic factor, the cost of the project is not high, which is why it is applicable, also given that if we go to the aspect of control, it will reduce the cost of electrical energy that is wasted in the different sports spaces or other environments.

Therefore, this project is feasible because it is a proposal for the application of knowledge, abilities and practical skills related to electricity by a team of teachers and students of the electricity degree course.

Methodological development

Materials and Methodology

For the elaboration and execution of the present work, a work team and the necessary logistics will be required. Thus, the work team will be made up of 2 teachers (research and interaction teacher) and 2 students of the sixth semester of the Electricity course, under the supervision of a person in charge, who in this case is one of the teachers.

The materials used are mentioned below:

- 1Plc Easy-Soft Model 3.0
- 3 Single-phase Thermal Relays
- 3 Contactors
- 50 terminal blocks
- 3 5mm by 10mm Cable Cover Bars
- 1 Roll of Flexible Cable No. 14
- 7 Thermomagnetic Switches
- 3 Insulating Tapes of Different Colours
- 6 Reflector (150w)
- 1 Masquin
- 6 Push Buttons with Na and Nc
- 10 Signal Lights of different colour
- 1 Sheet of Pressed Cardboard 2.40m by 1.22m (For Scale Model)
- 1 Liter of Glue for Pressboard
- 150 Screws (1 inch long and 4mm Diameter)
- 1 Neutral Bar 2cm * 30cm
- 1 Square Tube Profile Bar (1cm2)
- 1 M of Bar (Rail, Rail, Tab)
- 1 Drill
- 1 Computer
- 1 Printer
- 1 Camera
- 1 Pc Screwdriver Set
- 1 set of pliers
- 1 Hammer
- 1 Digital Tester
- 1 Analog Tester
- 1 Pole Finder
- 1 Banner
- Desk Material
- Welding Arc
- 5 Pairs of Gloves

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- Welding Gun
- Mechanic Lock
- 5 Protective Goggles
- 1 Grinder
- 1 Roll of Tin
- 1 Wear Disc
- Printer Ink

The methods used are:

- Documentary analysis, which will allow the study related to the control of lighting in sports facilities, both nationally and internationally, i.e. documents, publications, regulations that have to do with the topic addressed.
- Comparative study, which will allow us to study the different trends in the development and generalities of automated systems.
- Systematisation, which will enable us to organise the sports field.

To obtain information about the reality of the situation, a survey will be carried out to obtain data related to the subject in question.

Observation will also be used at different times during the research, as it will reveal different aspects of our object of study.

Results and discussion

Results obtained

The results of the project are expressed in the following tables where the following parameters that are necessary to carry out the construction in reality are calculated.

Parámetros de magnitud	nombre	Dato	Calculado
Superficie del terreno a iluminar	Metros 2		540 m2
Flujo luminoso total	lúmenes		450000 lm
Flujo luminoso del reflector	lúmenes	55000 lm	
Numero de luminarias	unidad		8 lamp.
Potencia total	vatios		3200 W

Table 1 Calculated data

The cross-section of the conductors to be used was divided into four sections for the corresponding reflectors and a general or main section, which is detailed in the following table.

Main section to section number four is tabulated from top to bottom accordingly.

Demanda Maxima Prevista (Kw)	Número De Fase Hilos	Conductores De Cobre Con Aislamiento Pvc				Canalizacion De Acometida Tubo Galvanizado	Aislado Tipo Rodillo	
		Fase		Neutro				
		AWG	mm 2	AWG	mm 2	Diametro Interno	0	L
3,2	1-2	12	3,3	12	3,3	3/4	1 3/4	11

Table 2

The cross-section of the conductors in the sections is:

Tramo	Sección del conductor	Equivalente AWG	Interruptor térmico de (amperios)
Primer tramo	1.86 mm^2	14	15
Segundo tramo	1.86 mm^2	14	15
Tercer tramo	1.39 mm^2	14	15
Cuarto tramo	1.39 mm^2	14	15

Table 3

After the calculations of the necessary parameters, the design of the automation circuit was continued with the corresponding software.

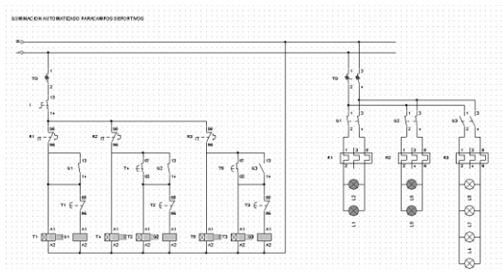

Figure 1 Circuit Design

Subsequently the circuit design was taken to the PLC language using the EASY-SOFT software, which is the language used by the PLC to carry out its connection.

Circuits designed in CADE SIMU and EASY SOFT

The circuits used for the time control process of the lights are divided into three with which the following reflectors are switched on: Q1 activates the reflectors 1-2, Q2 after a short time switches on the reflectors 3-4, and finally the contactor Q3 switches on the last four remaining reflectors 5-6 and 7-8, thus completing the total lighting of the environment. In the same way and in the same order they are automatically switched off.

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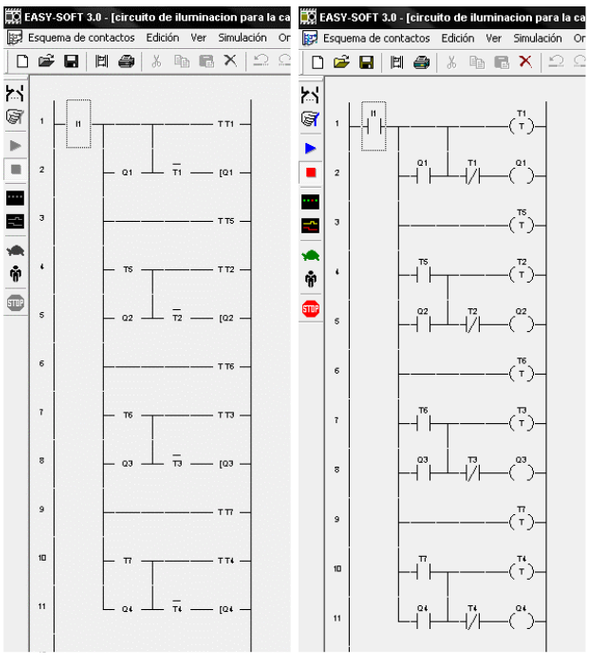

Device language ANSI/CSA language

Figure 2 Timing circuit for one hour

Timing circuit for two hours, figure 2, where only the timing time of the TTs varies in the following circuit and so the circuits are repetitive, varying only in the timing time of the TTs. These times are programmed before being installed and assembled in reality.

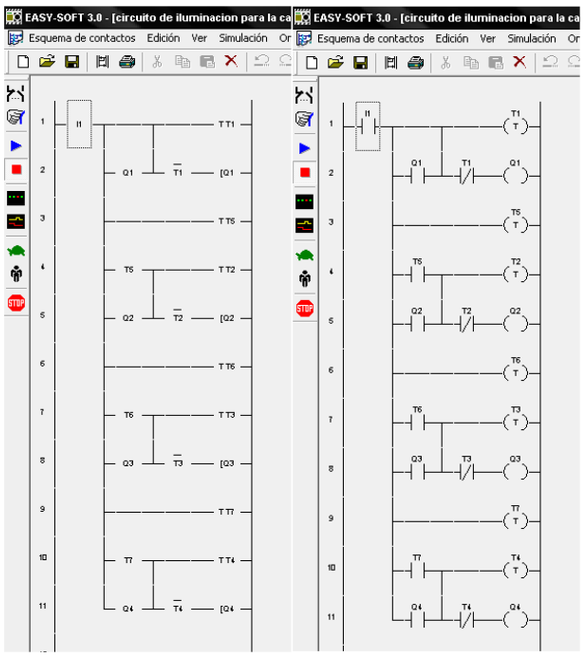

Figure 3 ANSI/CSA Language

The language or symbols that the program handles are the language of the device that the device works with and displays. While the ANSI/CSA standard is another type of symbology used by other PLCs, in our case we use the device symbology for the operation of the circuit.

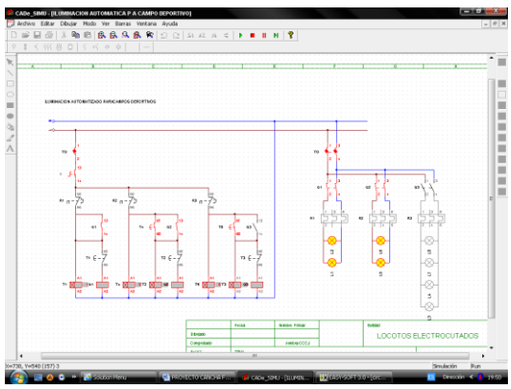

Figure 4 Simulation tests in CADe SIMU

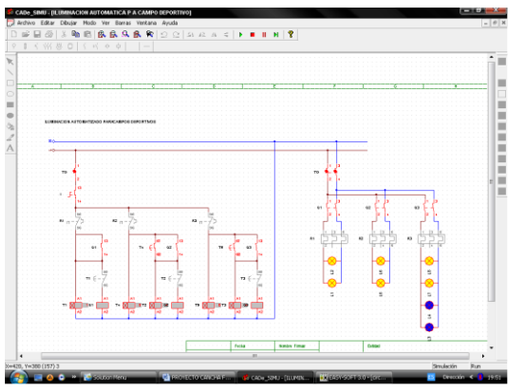

Figure 5 Simulation tests in EASY SOFT

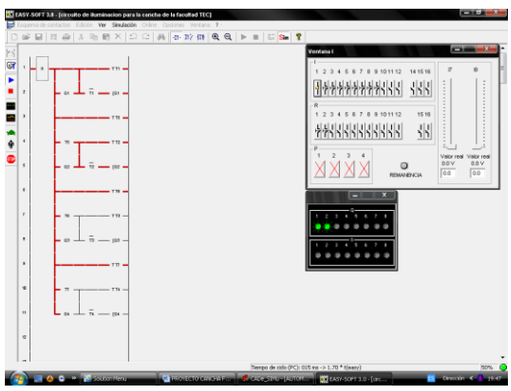

Figure 6

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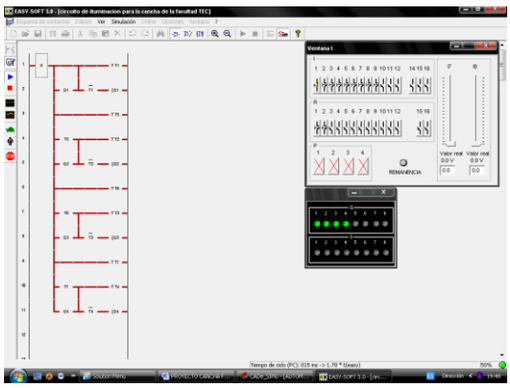

Figure 7

Discussion

In general, automatic lighting systems for sports fields do not exist in the local environment, although on the other hand, we can verify the existence of automatic lighting in public roads and parks, this type of automatic system has a limited application, switching lights on and off depending on the level of illumination of the solar spectrum, which makes it unfeasible in the application for the controlled lighting of a sports field.

An automatic lighting time control system is not only intended for sports fields, but also for other spaces such as: night-time education centres, university teaching centres, sports centres and others. In these public centres it is necessary to have lighting time control for an efficient organisation of the installation, and it could also reduce the demand for electrical energy of an installation and the cost paid for the kilowatt hours (kWh) used, and in some way help the environment.

The lighting control system gives us the great advantage of being able to control the lighting circuit from a single point by means of a computer or from the control panel itself, without the need to move around the installation to control and/or switch off the lights on.

Conclusions

Nowadays, needs go hand in hand with technology and technology meets human social needs. The computerised logic programmers better known as PLC are technological devices of wide application in automation processes.

The student-teaching team proposes and makes use of this technology to solve the lighting time control in a sports field, in order to provide a better organisation and/or administration of these recreational centres.

It is also worth mentioning that it does not estimate high costs, so its application will show real issues with practical solutions.

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