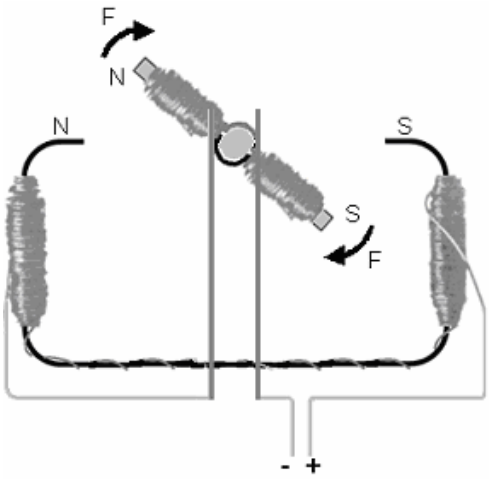


**Figure 14. Forces actuating on the rotor after a polarity change of its magnetic field**

# Slewing Crane With Electromagnet

Delfín Pedrosa, Joel Crespo, Daniel Costa and Joao Sena Esteves
*Dept. of Industrial Electronics. University of Minho. Campus of Azurém 4800-058 GUIMARÃES. Portugal*
*delfimpedrosa@gmail.com;*
*joelcresp@gmail.com;*
*daniel.o.costa@portugalmail.pt;*
*sena@dei.uminho.pt*

**Abstract**. This paper describes a slewing crane with electromagnet, operated by three three-phase induction motors. A switchboard described in a separate paper, which also depicts the electromagnet construction details, drives the motors and the electromagnet. From its seat – mounted on the crane – an operator can make the crane arm slew left or right. The electromagnet can be moved back, forward, up or down. The crane is made of iron, has a height of 3m and a length of 2,5m. Such proportions make it very suitable for science fair events.

**Keywords.** Electromagnet, Slewing Crane.

## 1. Introduction

A slewing crane equipped with an electromagnet is a very useful tool to move ferromagnetic pieces from a place to another. This paper describes such a crane, built for science fair events. Its first public appearance was the *Robótica 2006* festival (Fig. 1). Building this kind of equipment improves construction skills and promotes the study of Electromagnetism fundamentals, such as Biot-Savart's law [1, 2].

## 2. Crane dimensions and operating details

The crane has a weight of 395 kg, a height of 3m and a length of 2,5m. The base is a 1,20m x 1,20m square. More detailed dimensions are shown in Fig. 2.

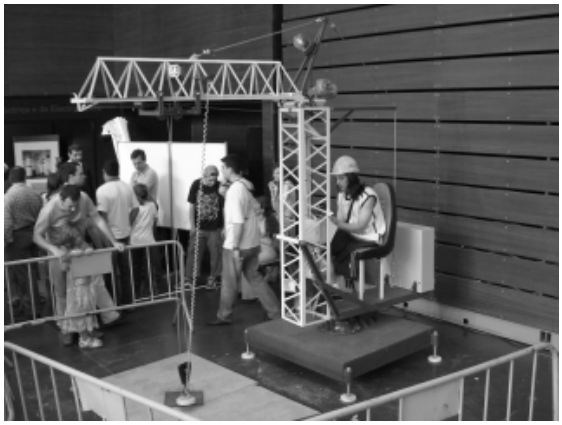

**Figure 1. Crane operating at *Robótica 2006* festival**

Three three-phase induction motors, each one equipped with a reduction gear, produce the crane movements.

A switchboard located at the rear of the crane controls the motors and the electromagnet. The switchboard and the electromagnet are both described in a separate paper. A control panel is located on the front part of the crane, where the operator has a good view of the pieces to handle. From a comfortable seat (Fig. 2), the operator can make the crane arm slew left or right. The electromagnet can be moved back, forward, up and down (Fig. 3).

For safety reasons, the crane is only allowed to slew within an 180º angle. This results in a working space whose top view has the shape depicted in Fig. 5.

The electromagnet (Fig. 6) and the structure of the crane are strong enough to elevate a weight of 50kg to a height of 2m from the ground.

© 2006 H-Sci ISBN 989 9509 50 7

The crane is foldable (Fig. 7, Fig. 8 and Fig. 9), which is very convenient for transportation and storing.

## 3. Materials used to build the crane

The crane was built with:

- 10m of 30mm x 30mm angle iron;
- 24m of 16mm x 5mm iron bar;
- 6m of 25mm x 25mm iron tube;
- 2m of 30mm x 30mm iron tube;
- 5m of 150mm U-shape iron bar;
- 4m of 50mm U-shape iron bar;
- 2m of 65mm U-shape iron bar;
- a 1,7m x 1,2m iron sheet;
- 4 medium pulleys for steel cable;
- 8m of 4mm steel cable;
- 5m of 8mm steel cable;
- a truck hub;
- a seat;
- 4m of steel chain;
- 3 three-phase induction motors, each one equipped with a reduction gear

**Figure 2. Operating the crane**

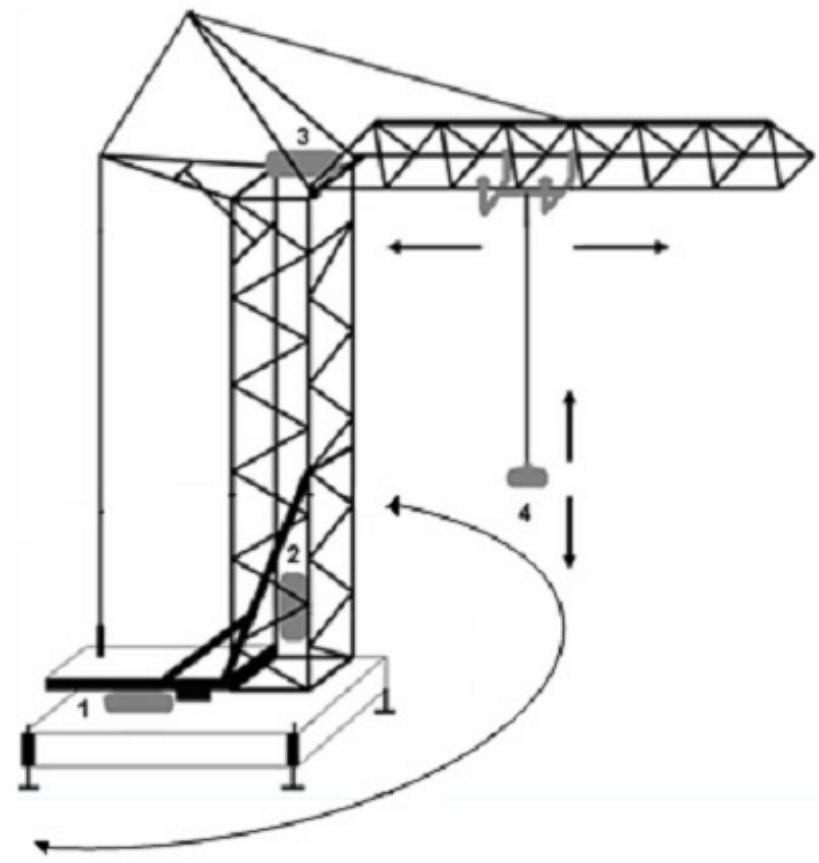


**Figure 3. Crane and electromagnet movements**

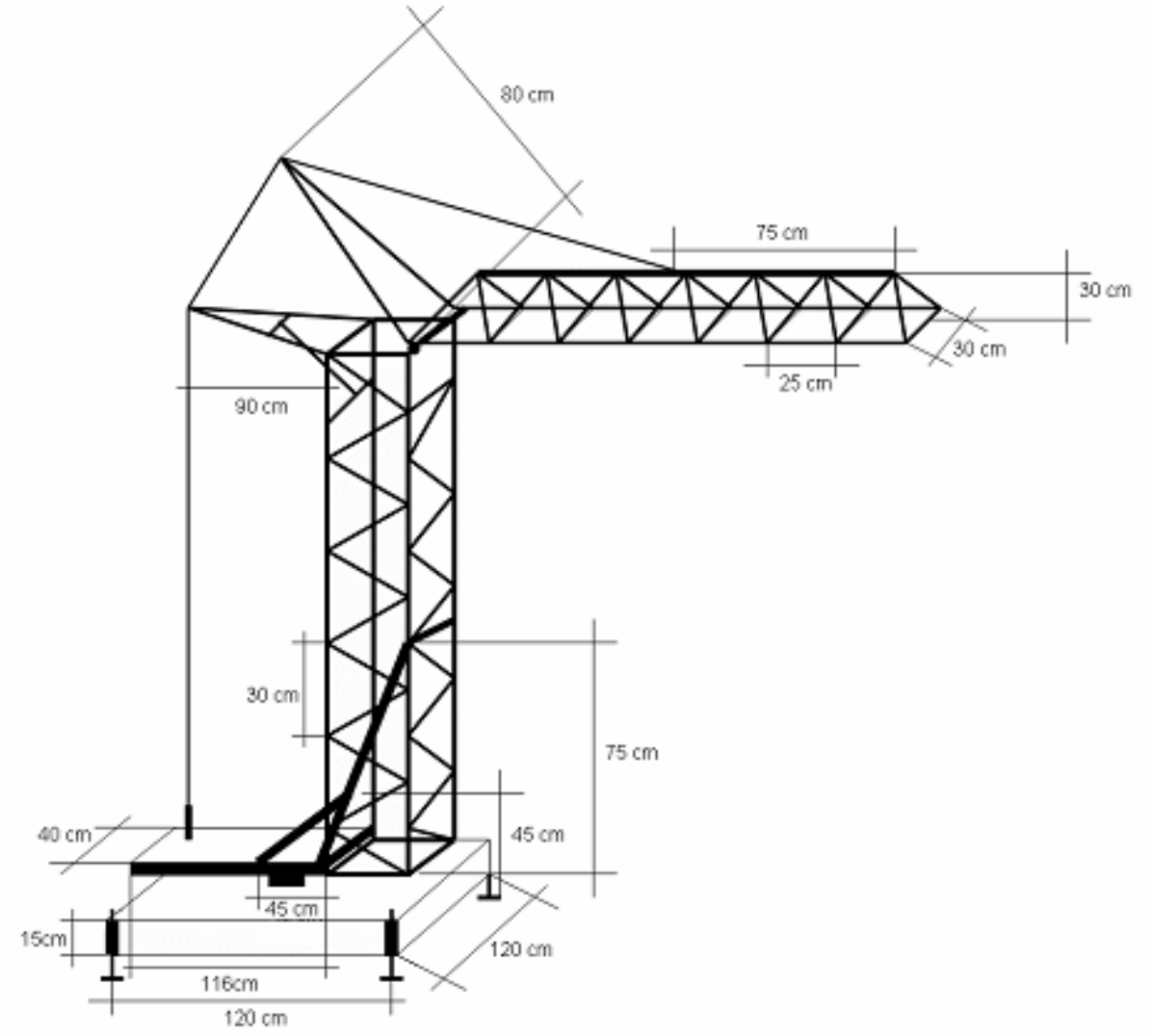


**Figure 4. Dimensions of the crane**

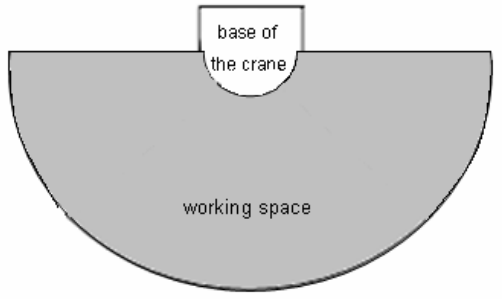


**Figure 5. Top view of the working space of the crane**

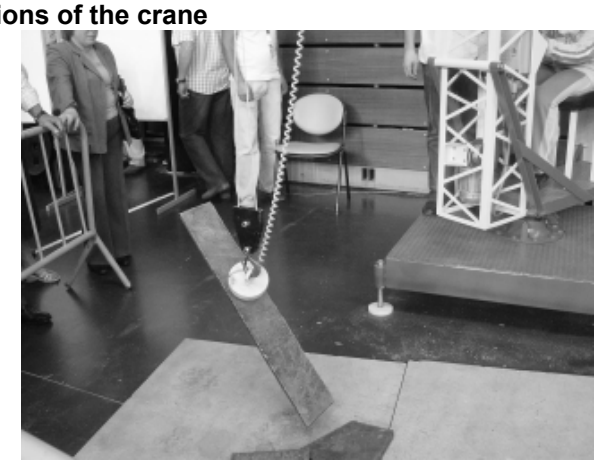

**Figure 6. Electromagnet elevating an iron piece**

© 2006 H-Sci ISBN 989 9509 50 7

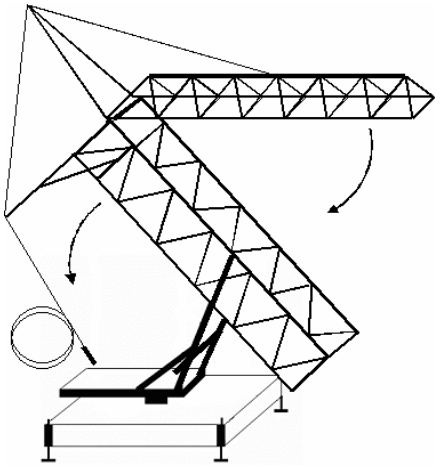

**Figure 7. Folding the crane**

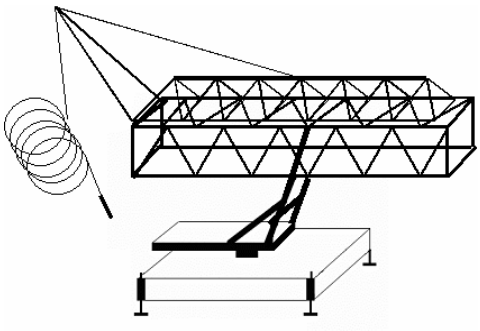

**Figure 8. Folded crane**

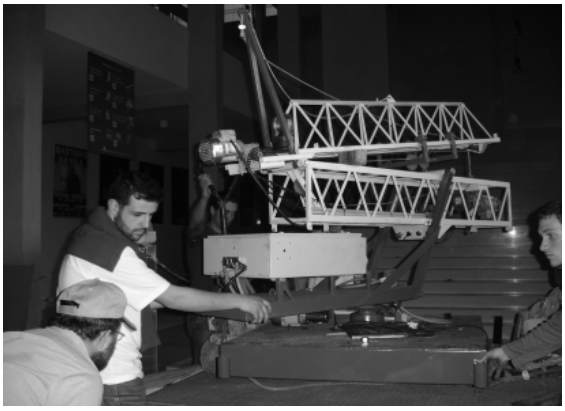

**Figure 9. Folded crane being transported**

## 3. Conclusions

A slewing crane equipped with an electromagnet has been presented. The device, built for science fair events, is capable of elevating ferromagnetic pieces of 50kg to a height of 2m from the ground.

Three three-phase induction motors produce the crane movements. An operator can make the crane slew left or right within an 180º angle. The electromagnet can be moved back, forward, up or down.

This kind of project develops the construction skills of the builders and promotes the investigation of Electromagnetism fundamentals.

## 4. Acknowledgements

The authors are grateful to Cátia Chamusca for the revising of this paper.

## 5. References

[1] Plonus, Martin A. Applied Electromagnetics. McGraw-Hill, 1986.

[2] Mendiratta, Sushil Kumar. Introdução ao Electromagnetismo. Fundação Calouste Gulbenkian, 1984.

# Computer-Controlled Model Railroad

Nino Pereira[1], Hélder Castro[2], João Sepúlveda[1] and João Sena Esteves[1]
[1] *Dept. of Industrial Electronics. University of Minho.*
[2] *Dept. of Civil Engineering. University of Minho.*
*Campus of Azurém. 4800-058 GUIMARÃES Portugal.*
*ninopereira@sarobotica.pt;*
*mjs@dei.uminho.pt;*
*helder_castro2005@yahoo.com.br;*
*sena@dei.uminho.pt*

**Abstract**. Model railroads are good test beds for several scientific experiments on Electromagnetism, Electronics, Automation, Control and Computer Science. Moreover, they are eye-catching structures very well suited for science-fair events. This paper describes a 2m x 1m model railroad layout and a user-friendly program, built with LabVIEW graphical language. The program is able to control train direction and speed, and also allows the control of thirteen switch-points, lights and a mountain funicular, all included in the layout. The interface between personal computer and railroad circuits is done with a standard multi-purpose data-acquisition board for the PCI bus.

**Keywords.** Automation, Computer Control, Interface Circuits, *LabVIEW* graphical language.