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Modeling of a Control Access Gate

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Abstract
Control access gates are widely used for their ability to help organizing and securing different events and activities which are made to make the daily life of humans more smooth and efficient. The aim behind this paper is to discuss the different types of access control gates technologies and what are the cons and pros of implementing each technology. One project conducted at the Hashemite University in Jordan of a simulation of a full height turnstile is also described in terms of its components and how they are connected to each other. This work can be used by undergraduate mechanical and mechatronics engineering students in order for them to understand the basics of access control gates, and can also be used by professors of different engineering disciplines to help their students understand more about access gates in specific and control systems in general.

Keywords: modeling, access gates, control system, turnstile.

INTRODUCTION

Access control gates can be used to make different places more secure and well organized. They are used in airports, museums, public transports, stadiums and many other different applications. In addition, access control gates provide more benefits other than securing and organizing, namely, they can be utilized to count the number of people passing through them and also to monitor the process of entering into and exiting from certain places. Gates for disabled people are found next to turnstile gates to help them pass through with convenience. Turnstiles can also be used to control the process of charging money. These advantages make this technology an attractive system to be looked into in terms of its types and its components. Access control gates come in a vast amount of categories. One of the most common types of turnstiles is the half-height or the waist-height turnstile as shown in Figure 1. This type of turnstiles is known with its user friendly design. It usually comes with a sensor and a motor when the user pushes the arm with a certain force the sensor decides at which speed the arm will rotate. The half-height turnstile like other turnstiles can be connected to a bar code reader or it comes with a token slot to allow access only after payment. One of the disadvantages of this technology is that some users might jump over it to avoid paying the charge. The latter disadvantage can be eliminated by using the full height turnstile shown in Figure 2 which is more heavy, costly and bulky than the half-height turnstile and is somehow close in shape to the revolving door. It is usually made from steel and it has two types: high entrance/exit turnstile (HEET) and exit-only turnstile. The difference between the two is that the (HEET) allows direction in both ways, while the exit-only allows the flow of pedestrians in one way only. The exit only technology is useful in crowded places where the flow of pedestrian is quite intense.

A third type of access control gates is the optical turnstile shown in Figure 3 which relies primarily on electronic infrared beams. Such type of turnstiles does not rely on physical barriers rather it issues an alert (a sound or a light) to warn security guards or staff in charge of an entry or an exit of an unauthorized people or items.

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Figure 1: Half-height turnstile.

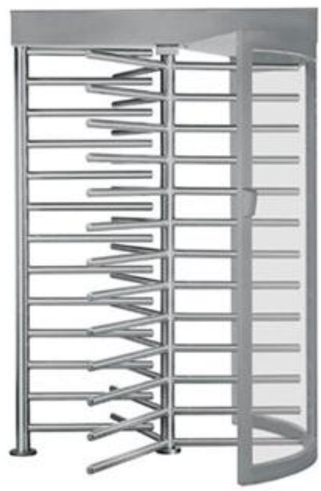

Figure 2: Full-height turnstile.

University related and engineering students' projects are of great importance and cannot be ignored. Fresh minded people may have brilliant ideas that can be extended into excellent research topics and in some situations the ideas can be expanded to give valuable research results. In [1], a hybrid solar system student project was extended into a research result. Furthermore, the topic was expanded to find the conditions for maximum efficiency of a solar integrated system [2]. This research led to adaptive prediction of the system [3] and simulation with adaptive neural networks [4]. Based on a university project at The Hashemite University in Jordan sun angle data was utilized to build a solar tracking panel and the results of this project in addition to using neural networks in the adaptive and non-adaptive modes came up with interesting research results [5]. Last but not least, at The German Jordanian university in Jordan a solar system project led to results regarding its feasibility [6].
A university project that solved an industrial problem of load cell calibration was presented in [7]. The load cells were measuring the weight of grains in two silos and they had faulty readings. Experiments were performed and a calibration formula for the load cells was proposed.

Figure 3: Optical turnstile.

PROJECT DESCRIPTION

The basic idea of the project done at the Hashemite University in Jordan is to make a simulation of a turnstile gate using basic mechanical and electrical parts which are available in the market with an affordable price in order to study how these parts are connected with each other for the gate to function properly. Three main mechanical parts were used: a wood base, a 30 mm diameter bearing and the metal gate which consists of the arms and the base. In order for the gate to rotate it is fitted into the bearing and the bearing is clamped at the bottom in the center of the wood base as shown in Figure 4.

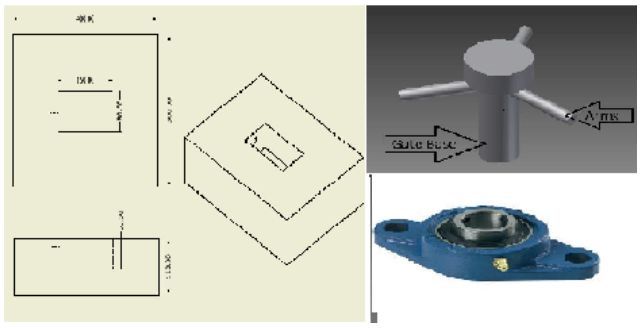

Figure 4: Mechanical parts used.

The project consists of 7 main electrical parts: Uno Arduino, RFID, relay, LCD screen, IR sensor, LEDs and a solenoid valve. The Arduino is programmed by either C or C++ languages; it comes with software library called "Wiring" that makes different commands easier to deal with. Users only need to define two functions to make a runnable cyclic executable program:

- Setup (): a function runs once at the start of a program that initializes settings.
- Loop (): a function called repeatedly until the board powers off [8].

SYSTEM PERFORMANCE

The RFID is connected with the Arduino as shown in Figure 5. As a credential is presented to the RFID it sends the information to the processer which compares this information with the access control list and based on that it will either accept or deny the given input. If it denies the input the door remains locked. If there is a match between the credential and the access control list, the control panel operates a relay that in turn unlocks the door.
The screen is an output device which prints anything you need (outputs, statement, numbers, etc.). In this project it is used for: displaying a counter for the number of entries and for welcoming anyone who enters the gate. There are two LEDs used in this circuit: red LED which will turn on when the gate is closed otherwise it is off and a yellow LED which will turn on when the gate is open otherwise it is off. An electromechanical solenoid valve which consists of an electromagnetically inductive coil, wound around a movable steel or iron slug is used. The main function of this solenoid is to act as a locking mechanism to lock the door, and only opens when the ID card is used on the RFID.

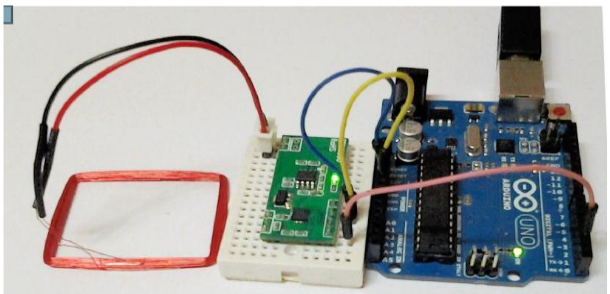

Figure 5: Connection between Arduino and RFID.

The model access gate controller performed well and completed its tasks when tested. The model serves as a good experiment for university students to learn the principle of operation and concepts for access gates. It uses up to date technology to enhance the performance of access gates.

CONCLUSIONS

A model for controlling access gates was built and simulated. The system represents a great demonstrative experiment for university students towards mechanical, mechatronics, industrial and electrical engineering. It also sets the background as a bench mark model for further developments and advancements.

REFERENCES

[1] M. A. Hammad, Experimental study of the performance of a solar thermal-photovoltaic integrated system, Renewable Energy, Vol. 4, 1994, pp. 897-905.
[2] M .S. Ashhab, Optimization and Modeling of A Photovoltaic Solar Integrated System by Neural Networks, Energy Conversion and Management, Vol 49, 2008, pp. 3349 - 3355.
[3] M.S. Ashhab, Adaptive Prediction of the Performance of a Photovoltaic Solar Integrated System, International Journal of Thermal & Environmental Engineering, Vol. 3, 2011, pp. 43 – 46.
[4] R.H. Fouad, M.S. Ashhab, A. Mukattash and S. Idwan, Simulation and Energy Management of an Experimental Solar System through Adaptive Neural Networks, IET Science, Measurement and Technology, Vol. 6, No. 6, 2012, pp. 427-431.
[5] B. K. Hammad, R. H. Fouad, M. S. Ashhab, S. D. Nijmeh, M. Mohsen, A. Tamimi, Adaptive Control of Solar Tracking System, IET Science, Measurement and Technology, doi: 10.1049/iet-smt.2013.0293, 2014.
[6] M. S. Ashhab, H. Kaylani and A. Abdallah, PV Solar System Feasibility Study, Energy Conversion and Management, Vol 65, 2013, pp. 777 - 782.
[7] M. S. Ashhab, Calibration Model for Industrial Load Cells, Sensors & Transducers, Vol. 130, No. 7, 2011, pp. 91-102.
[8] Nicolas Sklavos, Micahael Hubner, Diana Goehringer, Paris Kitsos, System level design methodologies for telecommunication, Springer International Publishing, Switzerland, 2014.