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Design and Control of the Swing Gates with Implementation of Multiple Command Systems

The paper presents a drive system for a swing gate. The control of opening and closing of the gate was made in different ways: sound control, control by changing the light flux, control by overload protection, control by laser barrier, remote control and control from central panel. The gate is driven with a single motor which drives a mechanical motion transmission system. The drive system is controlled by a programmable smart relay.

Keywords: swing gate, drive system, sound control, smart relay.

1. Introduction

This paper was aimed the realization of an automation of swing gates, so that it can be controlled for opening and closing by multiple commands as possible, with practical applicability, and low investment cost. A swing operator is used when a gate (or two gates) open inward or outward away from the wall. Swing gates open with a rotation around a fulcrum, just like an ordinary door. When the gate's doors open, they usually turn inward thus requiring specific internal space. Knowing the dimensions and the approximate weight of the leaf gate, the sturdiness of the post and the leaf gate, the material it is made of, is necessary in order to choose the ideal automation system.

The recommended installation for a single or double leaf gate, if the space required for the opening of the leaf gate is reduced by the presence of walls or fences, is an endless screw motor, surface mounted.

It's also possible to choose among a wide range of motorizations, depending on the weight and the dimensions of the leaf gate, in order to have a system which is tailor-made, even if the leaf gate are big.

The ideal automation is a compact, sturdy, articulated arm: it allows the leaf gate to move smoothly and effortlessly.

The articulated arm allows maximum ease of installation if there are walls or obstacles near the gate's post, or if the pillars are too narrow and light for other motorizations.

If we looking for a minimum aesthetic solution impact, the ideal motorization is the underground installation, totally invisible: elegant and perfect if you are looking for a discreet system in order to increase the aesthetical value of your entrance.

The automations are usually powered by the 230V supply and 24Vdc, which, thanks to the low voltage alimentation, guarantees a safer functioning. Moreover, the 24Vdc power supply is recommended when an intensive use is necessary, which is usually requested for commercial and industrial application.

Currently there is a wide range of drive systems for automation of swing gates but they have several inconveniences: drive is usually done by two engines mounted one on each gate, drive command is only through the remote control, and not least these automation have a very high price.

2. Swing gate control circuits

The control of swing gate is accomplished through three types of commands: opening commands, closing commands, and protection commands.

Opening control commands have developed in four versions: opening from the central panel, opening by the level of sound, opening by the level of the light flux, opening from remote control.

Closing control commands have developed in three versions: closing from the central panel, closing from remote control, closing after a delay time performed using programmable relay.

Protection control commands have developed in the following protection systems: laser barrier, overload protection, stop button from the central panel and remote control, automatic locking, sensors for OPEN and CLOSED position.

Opening and closing of swing gate from the central panel is accomplished with pushbutton. If the time of coupling of the buttons is very short the command is not taken into account.

Opening of swing gate by the level of sound is achieved through a microphone and a signal adjusting circuit. The acoustic signal is picked up by a microphone CZN 15E, then is amplified and compared with a minimum threshold, set to exceed the background noise. If the signal received by the microphone exceeds the minimum threshold, sound signal will be "transform" into a counted pulse of programmable relay. Adaptation circuit is shown in figure 1. Opening of swing gate is controlled by programmable relay. Opening is allowed only for a fixed number of pulses during 10s.

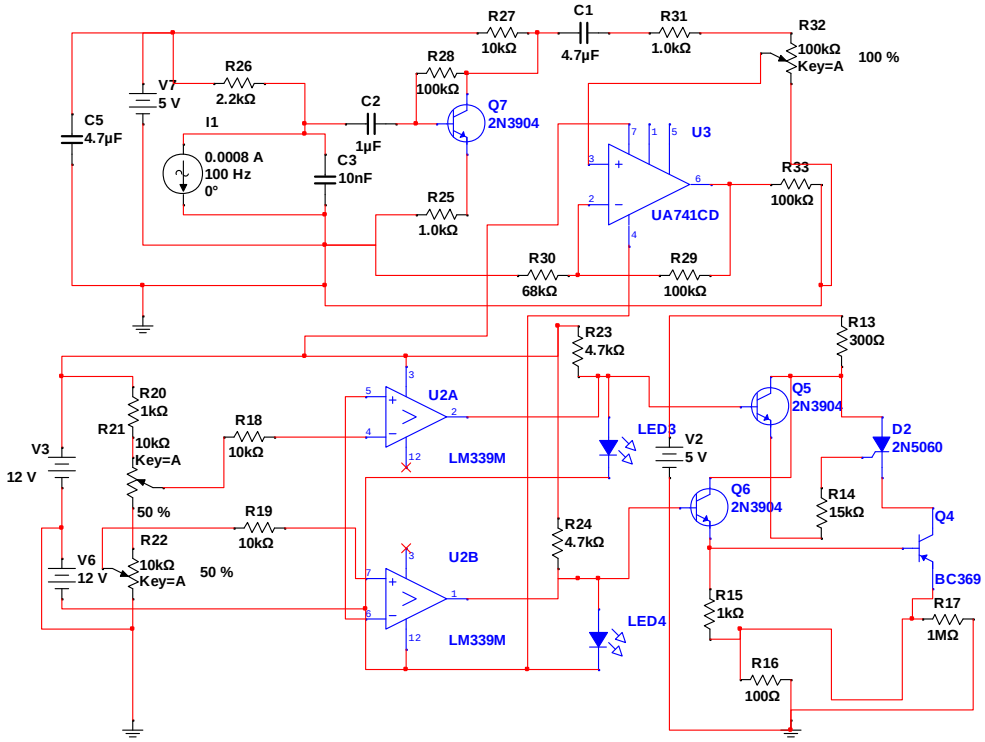


Figure 1. Sound signal processing circuit.

Opening of swing gate by the variation of light flux is achieved through a photoelectric sensor and a signal adjusting circuit. The light flux is picked up by a photoresistor located in the center of the stand, then is amplified and compared with a minimum threshold, set to exceed the light flux of the day. If the signal received by the photoresistor exceeds the minimum threshold, light flux will be transform into a counted pulse of programmable relay. Adaptation circuit is shown in figure 2. Opening is allowed only for a fixed number of pulses during 3s.

Opening and closing of swing gate from the remote control is done with a wireless radio receiver located in the control panel connected to programmable relay.

Closing after a delay time is achieved with the timer relay and laser barrier. Thus, if the laser barrier is active swing gate will automatically close from one minute after the last command. If the laser barrier is not active swing gate will not give any closing command and the delay timer will be reset. The laser barrier is a protection system if in the direction of the two gates is any obstacle that interrupts the laser signal. Laser signal reception and adaptation circuit is shown in figure 3.

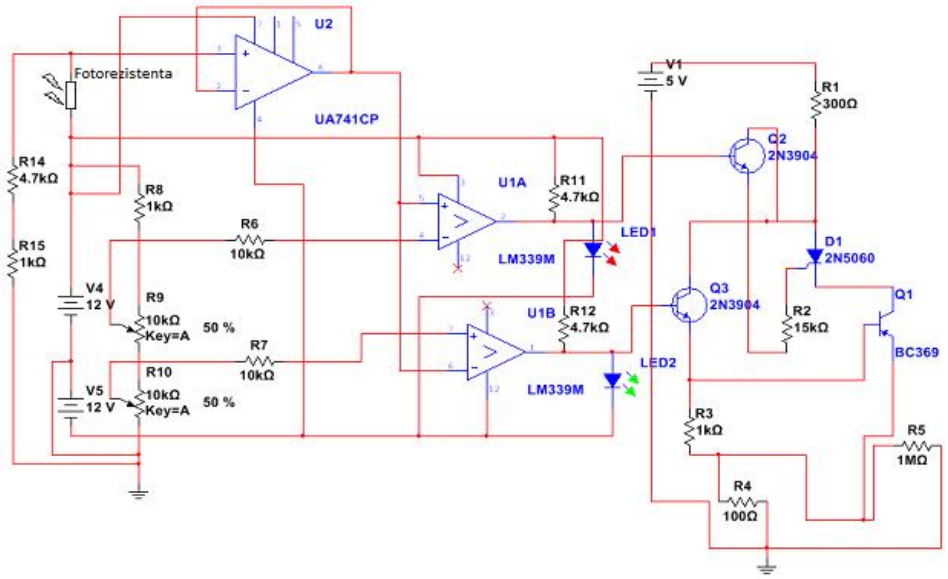


Figure 2. Light signal processing circuit.

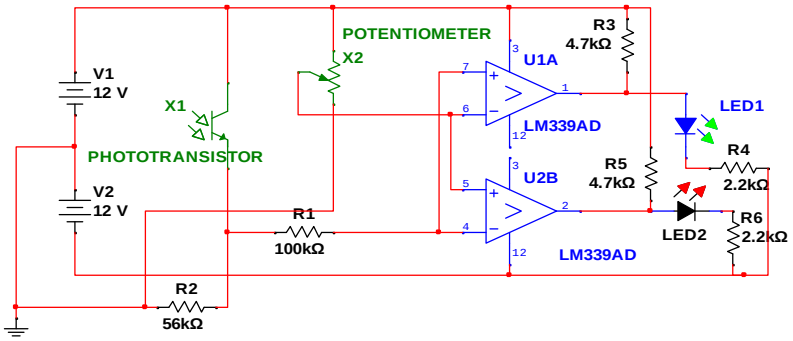


Figure 3. Laser signal reception and adaptation circuit.

The overload protection systems circuit is designed to perform motor overcurrent protection, overcurrent due to the appearance of obstacles, which gates come into contact when they are in motion of opening or closing. Overcurrent protection is achieved with current transducer LA 55-P. In the case of this system drive is important that the mechanical system does not have a moment of inertia too high to enable current protection at startup. Protection circuit diagram is shown in Figure 4

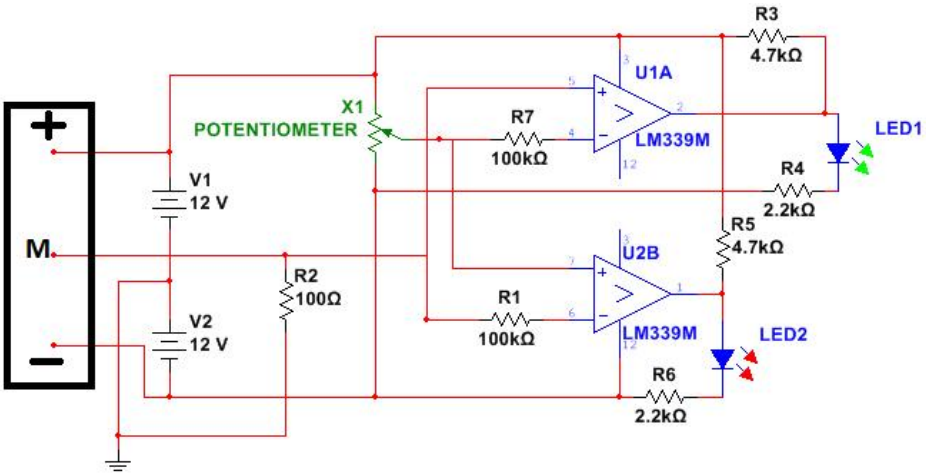


Figure 4. Laser signal reception and adaptation circuit.

3. Experimental data

Zelio Logic Relay is programmable using the Zelio Soft program or in Direct Entry Mode (Ladder language). Zelio Soft program allows to program software in FBD language or in Ladder language. A small part of the program implemented on relay, written in FBD language can be seen in Figure 5

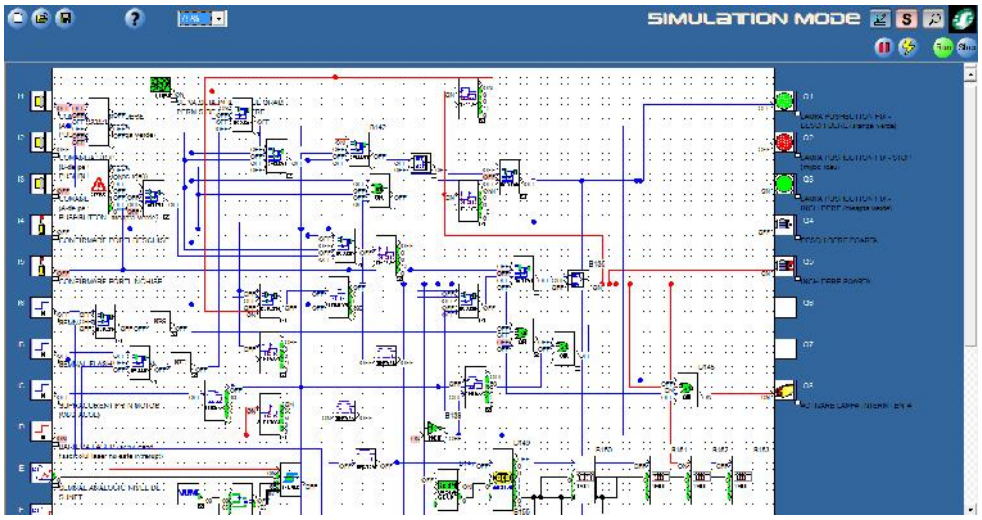


Figure 5. The interface of control program implementation.

The electrical circuit realized enables system operation with analogue control or digital control. In the case of digital control the formatting of analog signals is done in software programming environment. In the case of analog control the formatting of analog signals is done by adapting signal boards.

In Figure 6 are presented a series of signals taken from the analog signal processing circuit of sound.

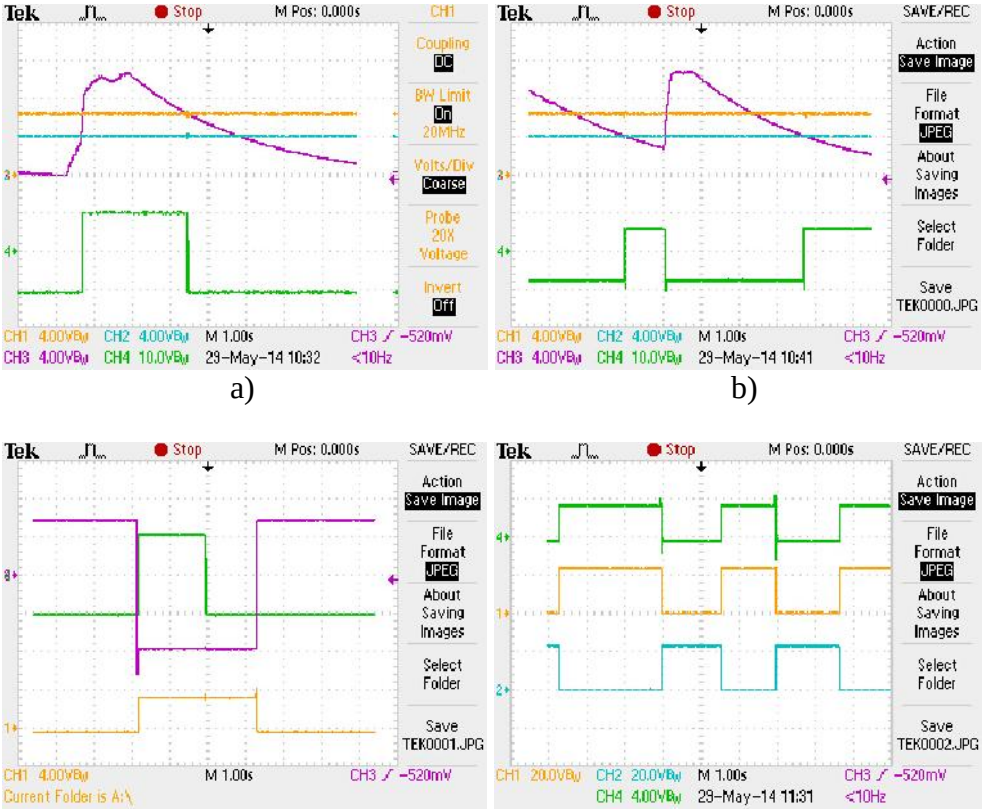
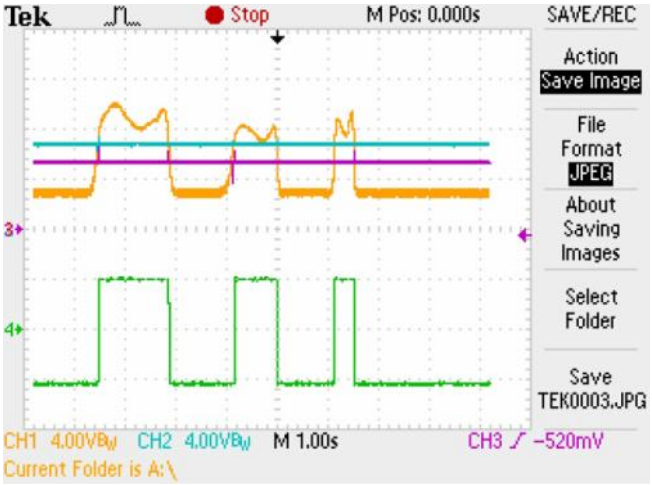


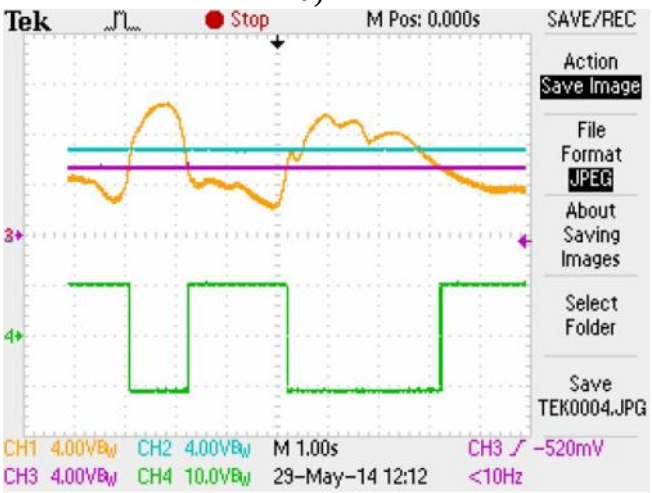
Figure 6. Signals taken from the analog signal processing circuit of sound.

In Figure 6 a) and Figure 6 b), the signal CH1 and CH2 is the limits of the hysteresis band. If sound signal CH3, increases above the upper limit CH1 will be made a signal that has the role of command activation of relay. If sound signal CH3, decreases above the upper limit CH2 will be made a signal that has the role of command deactivation of relay. These two signals form actually the impulse on the input programmable relay that can be seen on Figure 6 c). In the end the control signal is raised to a higher voltage, compatible with digital input of relay.

In Figure 7 are presented a series of signals taken from the analog signal processing circuit of light. In Figure 7 a) and Figure 7 b), the signal CH1 and CH2 is the limits of the hysteresis band. If light signal CH1, increases above the upper limit CH2 will be made a signal that has the role of command activation of relay. If sound signal CH1, decreases above the upper limit CH3 will be made a signal that has the role of command deactivation of relay.



a)



b)

Figure 7. Signals taken from the analog signal processing circuit of light.

4. Conclusion

The automation of swing gate performed using Zelio Soft 2 software meets all requirements at the design stage such as: opening and closing of swing gate from the central panel and from remote control, opening by the level of sound, opening by the level of the light flux, closing after a delay time performed using programmable relay. The automation have the following protection systems: laser barrier, overload protection, stop button from the central panel and remote control, automatic locking, sensors for OPEN and CLOSED position.

A very important aspect of the automation is its cost price, which is half that of similar devices on the market.

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