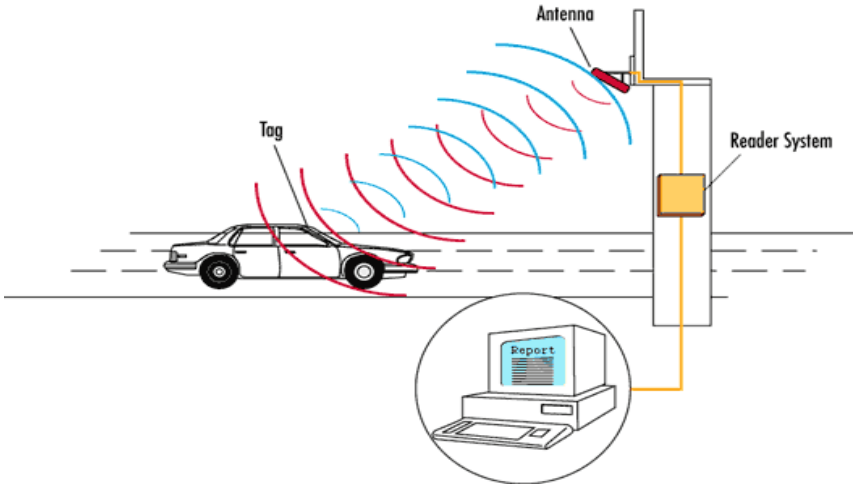
EE213 ELECTRICAL CIRCUITS LABORATORY
TERM PROJECT
ANALOG PARKING LOT ACCESS CONTROL SYSTEM

1. INTRODUCTION

Parking lot access control systems are widely used in places where only authorized entrance is allowed. In general, these systems only check the cars for being authorized to enter the parking lot regardless of the availability of parking spaces. However, a more advanced access control system can allow the vehicles only if there is an available place in the parking lot and guide them to empty spaces.

Access control systems may be investigated under two main parts, namely, sensory system and control unit, both of which are located in parking lot. In addition, each vehicle must present an identity so that the system can check whether the presented ID has privilege for entrance or not. The communication between the ID component in a vehicle and the access control system is realized via radio frequency and the barrier is opened as long as the presented ID is listed on the processing system, which is possibly a computer. The control unit of access control systems is illustrated in Figure 1.



(a)

(b)

Figure 1. Parking lot access control system illustrations (a) [1] (b) [2]

On the other hand, sensory system is utilized for sensing whether there is an available parking space or not. Output of the sensory system is continuously fed to the processing unit, which leads control unit to open or the barrier or keep it closed. An example sensory system is illustrated in Figure 2.

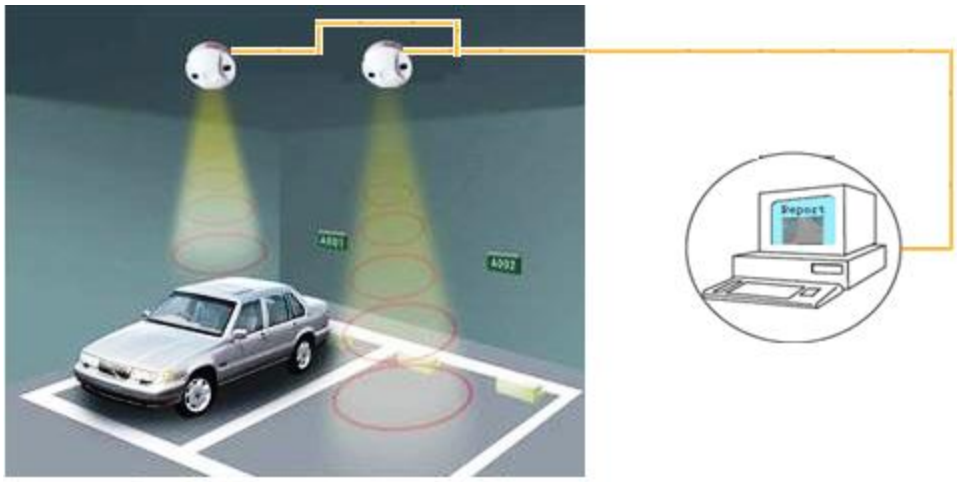


Figure 2. Sensory system

2. PROJECT DESCRIPTION

In this project, you are required to design an access control system in a parking lot. Your parking lot must contain two parking spaces, availability of which will be inspected by the sensory system. A control unit should be present at the entrance of the parking lot and it should allow vehicles with a valid identity to go in if there is an available parking space inside the parking lot. You need to construct a separate circuit representing a vehicle so that you can demonstrate the operation of your access control system.

2.1 SENSORY SYSTEM

Sensory system must consist of two sensors, one for each parking space, and a sensor control unit. Sensor control unit is supposed to find out the number of available parking spaces from the sensor output signals, which should be transmitted to the access control unit.

2.2 ACCESS CONTROL UNIT

Access control unit must contain a proximity sensor, an ID detector, an availability indicator, a decision unit and an entrance barrier. The control unit will be activated by the output of the proximity sensor, which will sense the presence of a vehicle at a given distance from the entrance. Once the control unit is activated, the ID detector is supposed to check the identity of the vehicle awaiting for the entrance. Access control unit will allow the authorized cars go in if there is an available parking space. The number of available spaces in parking lot must be indicated all the time.

2.2.1 PROXIMITY SENSOR

For sensing the proximity of vehicles, you should use a laser pointer and a Light Dependent Resistor (LDR). The laser pointer will represent a vehicle which will try to enter the parking lot and therefore, related circuit must be constructed separately from the access control system. The pointer should emit

light constantly, which will carry the identity information of a car. A laser pointer should be modified to work with the DC supply of your overall system, rather than batteries. ID detector will be activated by the help of the change on the resistance of LDR when a vehicle is present at a predefined distance away from the barrier.

2.2.2 ID Detector

Authorization ID will be a predefined duty cycle of the rectangular waveform that will be fed to the laser pointer as the input signal. The detector should sense the duty cycle of the signal emitted from the awaiting vehicle and inform the decision unit in case of an authorized ID detection.

2.2.3 Decision Unit

If there is an available parking space when an authorized ID signal is detected, the decision unit should send an opening signal to entrance barrier. Therefore, decision unit is supposed to take two inputs from ID detector and sensory system, and give a single output.

2.2.4 Availability Indicator

Availability indicator must indicate the number of available parking space as the color of the light emitted from a RGB LED, which is shown in Figure 3.

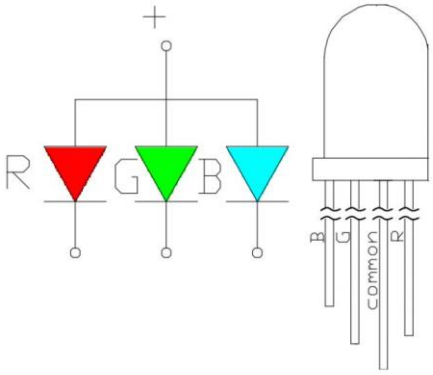


Figure 3. RBG LED [3]

Indicator should emit green light if both parking spaces are available, blue light if one the parking space is available and red light if there is no available parking space.

2.2.5 Entrance Barrier

Entrance barrier should be composed of a boom and a DC servo motor. Boom must be mounted to the rotating part of the motor to represent the barrier. You can see a servo motor in Figure 4 and example of entrance barrier in Figure 5.

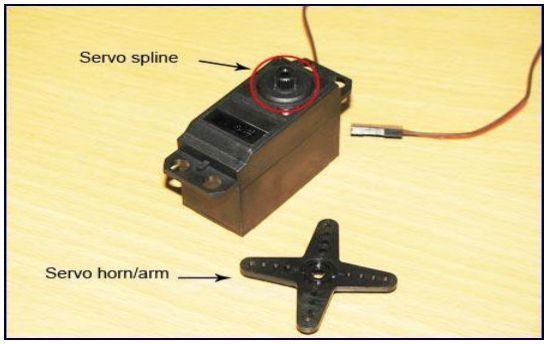


Figure 4. Servo motor [4]

Figure 5. Entrance barrier [5]

3 RULES AND REGULATIONS

3.1 ALLOWED COMPONENTS

You are allowed to use +/-25 V output of DC power supply and you may use any types of resistors, capacitors, inductors, diodes, LEDs, LDRs, op-amps, transistors, DC servo motor (without encoder).

3.2 DESIGN SPECIFICATIONS

Will be announced later.

3.3 BONUS

Will be announced later.

3.4 GROUPS

The project will be carried out in groups of two students. The students in the same group should be in the same laboratory session.

3.5 IMPORTANT DATES

- November 20 : Project Announcement
- December 6 : Announcement of design specifications and evaluation rubric
- December 25 : Deadline for pre-reports (till 17.00)
- December 28-January 8 : Laboratory sessions
- January 7-8 : Submission of demo-videos
- January 9-10 : Demonstrations
- January 12 : Submission of the final report (till 17:00)

3.6 DOCUMENTATION

You **must** submit two reports and a video for the term project.

3.6.1 REPORTS

As stated in report guideline, pre-report should include an introduction, pre-design of the project with circuit diagrams, theory, formulations, simulation and experimental results and a conclusion.

Final report should also include all the parts in the pre-report for the overall design. In other words, final report should explain the overall design with an introduction, a block diagram and circuit schematic, operation of each sub-block with theory, formulations, simulation and experimental results. Final report should also include analyses for the cost and power consumption of the project and you should justify the use of each component. Conclusion of the final report is very important since it reflects your understanding of the project and the experiences you gained during the overall process. The objectives, results and the experiences should be clearly presented. This does not necessarily mean a long report, but definitely a well-organized one.

Late submissions for both reports will lower your report grades as:

- %20 off for one-day late submission
- %50 off for two-day late submission
- %90 off for three-day late submission
- Zero credit for more than three-day late submission.

You are referred to the report guideline, which is available on the course website, for further details.

3.6.2 DEMONSTRATION VIDEO

You should prepare a 6-8 minute video where partners of each group present the project in a collaborative manner. The video should include the explanation of main blocks, why they are used and how they are designed. This video should be regarded as a formal presentation to the related assistant. Note that you should always appear in the video together with your presentation material.

3.7 GRADING

- Pre-Report : %15
- Final Report : %20
- Presentation Video : %10
- Design and Performance : %55 (partial credits are possible)
- Bonus : up to %30

3.8 REGULATIONS

- Attending to at least one project session and demonstration is a must for both team members, otherwise, you will fail the course.
- Cheating is strongly forbidden and any indication of cheating will cause you to get zero credit from the project. You can collaborate with your friends by exchanging ideas, not copying the design details or the reports. Using the design of another group with slightly modified component values will also be regarded as cheating.
- Both members of the group are responsible for every single detail of their circuit.

REFERENCES

[1] http://www.periohgs.com/perio-hgs.html
[2] http://www.plustech.com.tr/otopark-ogs-sistemi.html
[3] http://diyot.net/rgb-led/
[4] http://www.engineersgarage.com/articles/servo-motor
[5] http://www.timelon.com/Automation/Boom%20Barrier.html