Introduction

In this application note, we will explain how to use a SLG46140V GreenPAK IC to open and close an automatic door. We used a passive infrared (PIR) HC SR 501 sensor to detect the presence of humans near the boundary/surroundings of a door and then used the GreenPAK to control L298N motor drivers. The proposed design has wide applications in industry, offices, universities, shopping centers, etc.

Explanation

In this design, the PIR sensor detects the presence of a person based on the infrared levels emitted. The output of the PIR sensor is used as an analog input to the GreenPAK, which processes the input and manages signal timing.

When the PIR sensor outputs HIGH, the GreenPAK will open the door via the L298N motor driver circuit. If the PIR outputs LOW for more than 6 seconds, the door is then closed.

Figure 1. Flowchart of Automated Door Opening and Closing System
Passive Infra-Red (PIR) Motion Detector Module

A PIR sensor measures the infrared levels radiating from objects in its field of view. The sensor used in this app note has a range of about 6 meters. PIR sensors are able to sense motion, and are often used to detect whether a human has moved into or out of the sensor’s range. They are small, inexpensive, low-power, easy to use, and resilient. They are commonly found in appliances and gadgets used in homes and businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. All objects with a temperature above absolute zero emit heat in the form of radiation that is invisible to human beings because it is in the infrared region. The hotter the object is, the more infrared radiation is emitted. The passive term in passive infra-red sensor refers to the fact that PIR sensors don’t generate or radiate any energy for detection purposes. They work by detecting energy given off by other objects.

When a human passes in front of a PIR sensor, it converts their body heat into an output voltage change and this triggers the detection. When an object is detected, the output pin of PIR sensor has a voltage level of 3.3v. If no object is present it outputs approximately 0v. The PIR sensor is shown in Fig 2.

It has three terminals to connect it with the GreenPAK. The detailed description of each terminal is shown in Table 1.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out</td>
<td>Output</td>
<td>Pin that outputs 3.3v when infrared radiation is detected</td>
</tr>
<tr>
<td>+</td>
<td>V +</td>
<td>Connect to Vdd (5v)</td>
</tr>
<tr>
<td>-</td>
<td>Ground</td>
<td>Connect to ground</td>
</tr>
</tbody>
</table>

Table 1. PIR Sensor PIN Functions

L298N Motor Driver Module

This dual bidirectional motor driver module multiwatt15 package is based on the very popular L298 Dual H-Bridge Motor Driver IC. This module allows the user to easily and independently control two motors of up to 2A each in both directions. It has a high operating voltage that can be up to 40v. It can drive a two-phase stepper motor, a four phase stepper motor, or two-phase DC motors. It has a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load, enhancing reliability. It can drive 5v-35v, and its logic level is 5v.

The function that the motor driver performs is shown in Table 2.
Human Sensed Automatic Door Opening and Closing System Using PIR Sensor in GreenPAK

<table>
<thead>
<tr>
<th>Input 3</th>
<th>Input 4</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>Door remains closed</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>Door opens</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Door closes</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Door remains open</td>
</tr>
</tbody>
</table>

Table 2. Function of L298N Motor Driver

Block Diagram

The block diagram showing the connections among PIR sensor, the GreenPAK, and the L198N motor driver is shown below.

Clockwise Motor Control

When the PIR sensor senses an object in its range, it outputs HIGH on its OUT pin, which is connected to Pin10 of the GreenPAK. When the voltage on Pin10 rises above 1V, DFF4 is clocked, which passes POR (power on reset) through to Pin4, which is connected to the clockwise motor that causes the door to open.

The 2-second rising edge delay on CNT1/DLY1 and the inverter 2-L0 create a oneshot pulse which resets DFF4 when 2 seconds have elapsed.

Counterclockwise Motor Control

A 6-second falling edge delay on the ACMP output is created by CNT0/DLY0.
When the output of that delay block falls, the Falling Edge Detector in the P DLY block clocks DFF5, which is connected to another 2-second oneshot pulse circuit.

2-bit LUT2 is connected to Pin13, and is used to ensure that both motors are not attempting to operate in opposite directions at the same time. This LUT makes sure that the counterclockwise motor can only run when the clockwise motor is not attempting to run.

**Conclusion**

In this app note, we designed a Passive Infrared Automat Door Control system using the SLG46140V GreenPAK IC as the control unit. The small IC proved capable of performing this task properly and accurately. The GreenPAK was able to implement this solution with several component blocks left unused, which means a designer could add additional functionality to the GreenPAK design if necessary.

**Applications**

The proposed design can be used for the following applications:

1. In hospitals and scientific labs, automatic doors can be used to secure an area by ensuring that the doors remain shut, while reducing the risk of cross-contamination since people won’t need to handle the doors to pass through them.

2. For people in wheelchairs and other disabled individuals, automatic doors are a necessity, since conventional doors can be difficult to open for people with physical disabilities.

3. Automatic doors can be used in warehouses and other facilities where people frequently have their hands full, contributing to safety and efficiency by making it easier for people to get around.

![Figure 5. GreenPAK design for Automatic Door Control system](image-url)
Hardware Pictures

Figure 6. Hardware Demonstration
IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

© 2021 Renesas Electronics Corporation. All rights reserved.

Corporate Headquarters
TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Trademark
Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

Contact Information
For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/