Driving Stepper Motors

Stepper motors are used in printers, disk drives, and other devices where precise position control is required. Stepper motors do not turn continuously like DC motors. They move in steps such as 1.8 degrees. There are several types of stepper motors such as unipolar and bipolar. Electronic circuits driving these motors are different. A common stepper motor driver is Allegro A3967. A module for this driver is available at Sparkfun Electronics with part number ROB-08368 EasyDriver v3 Stepper Motor Driver, which is a simple to use and is compatible with 5V TTL signals. This module is applicable to driving bipolar stepper motors. The EasyDriver requires a 7V to 30V supply to power a stepper motor and has an on board voltage regulator for driving the internal logic circuitry. The A3967 driver on the module is configured for 8-microstep mode with adjustable current control from 150mA/phase to 750mA/phase. Pictures, ordering information and web link of the EasyDriver are shown below.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Part Number</th>
<th>Weblink for the part</th>
<th>Description</th>
<th>Unit Price</th>
</tr>
</thead>
</table>
Hardware interfacing to the Freescale 9S12C32 MCU
The wiring diagram below shows how to connect the EasyDriver to the microcontroller and a bipolar stepper motor. PT0 is connected to the Direction pin. PT1 is connected to the Step pin. Other GPIO pins can be used instead of PT0 and PT1. A low-to-high transition on the STEP pin will microstep the motor. The EasyDriver is configured with 8 microsteps for one increment in stepper positioning.

The motor direction control chart shows how to drive a stepper motor in clockwise direction. To drive it in the counterclockwise direction, simply reverse the sequence.

<table>
<thead>
<tr>
<th>Step</th>
<th>wire 1</th>
<th>wire 2</th>
<th>wire 3</th>
<th>wire 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>low</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>2</td>
<td>low</td>
<td>high</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>3</td>
<td>low</td>
<td>high</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>4</td>
<td>high</td>
<td>low</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>
Software development
In the wiring diagram above, the PT0 pin of the microcontroller drives the Direction pin of the motor driver. The PT1 pin drives the STEP pin of the driver. A C-function for initializing PT0 and PT1 as general purpose output pins is shown below.

Void init_PT01(void) {
    DDRT_DDRT0 = 1;
    DDRT_DDRT1 = 1;
}

To drive the stepper motor moving in the clockwise direction in one microstep, a C-function for that is shown below. When this function is executed 8 times, the stepper will have advanced one step.

Void clockwise(void) {
    PTT_PTT0 = 0;
    PTT_PTT1 = 0;
    Waitms(1); //hold at low level for 1 ms, can be long if necessary
    PTT_PTT1 = 1;
    Waitms(10); //hold at high level for 10 ms, can be long if necessary
    PTT_PTT1 = 0; //reset PT1
}

To drive the stepper motor moving in the counterclockwise direction in one microstep, a C-function for that is shown below. When this function is executed 8 times, the stepper will have advanced one step backward.

Void counterclockwise(void) {
    PTT_PTT0 = 1;
    PTT_PTT1 = 0;
    Waitms(1);
    PTT_PTT1 = 1;
    Waitms(5);
    PTT_PTT1 = 0;
}