EE454 Hardware project 4

Project 4 Report

Title: Light tracking servo system using the ARM board

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Abstract

The project consists of designing a microcontroller system that sweeps a photo sensor mounted on servo motor through 180 degrees. The photo sensor outputs the intensity of the light continuously swept during the rotation. HyperTerminal is used to indicate the angle of the brightest light and the angle of the dimmest light**.**

This project is implemented using the Philips ARM7 board

Main Components:

(1) ARM7 board

(1) Photo sensor

(1) Servomotor

(1) 10kΩ resistor

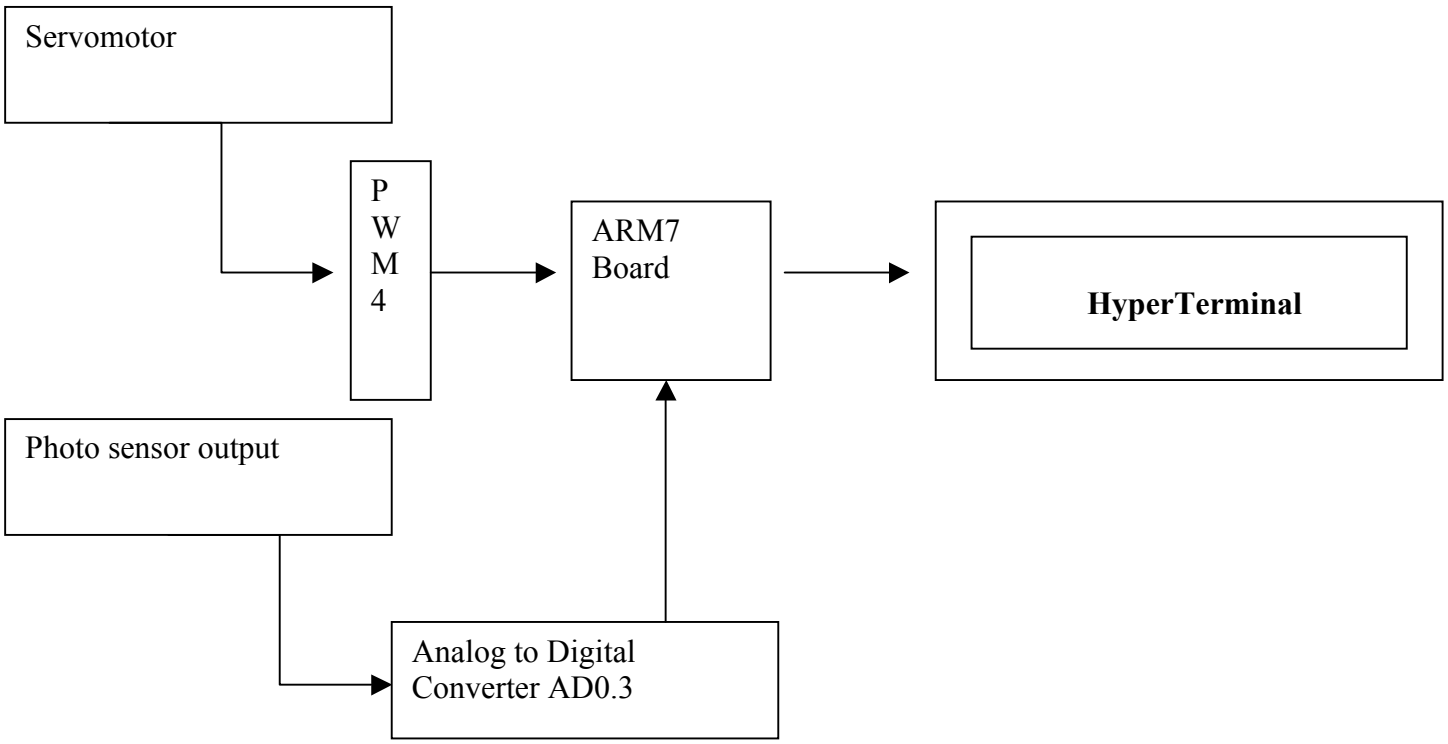


Figure 1: Connection Diagram

Description:

The program keeps tracks of the position of the servomotor in the main code routine. An angle is associated to every position of the servomotor. The photo sensor attached transmits an output voltage AD0.3 of the Analog to Digital converter, according the intensity of the light applied.

Calculations:

After testing the servomotor connected to the PW4, a 180 degrees rotation starts at 24000 counts and stops at 29000 counts

Number of counts for 180 deg = 29000 counts – 24000 counts = 5000 counts

For gradual 28 increments of the servomotor position:

counts per increment= $500028=178$ □□□□□□□ □□□ □□□□□□□□□□□

angle per increment= $180178\cong1$ □□□□□□□□ □□□ □□□□□□□□□□□

- Photo sensor:

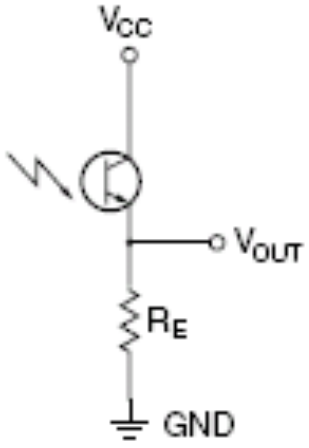


Figure 2. Common-Collector Amplifier

VCC = 3.3V

V_{OUT} varies according to the light intensity

R_E:
The value of R_E has been adjusted to give best results for the photo sensor light tracking.
$R_E = 10k\Omega$

Source Code Documentation:

- **Main program design**

1- Initialization

- Change GPIO P0.8 to PWM4 and enable RxD1 and TxD0
- Set up peripheral clock for 15MHz
- Enable PWM4 Output (bit12)
- Set the Period to 10ms
- Counter Enable, PWM Mode Enabled(bit0, bit3)
- 9600 Baud Rate @ 15MHz VPB Clock

The 180 degree angle has the high time going from 24000 to 29000

2 – While loop

2.1- Reset the servo to initial position and reset variables to zero

2.2- 'for' loop from 24000 to 29040, do a +180 degrees rotation

2.2.1- Update PWMMR4 value
2.2.2- Update the latch enable register
2.2.3- Get the A to D converter input voltage
2.2.4- Update the lowest and highest voltage and their corresponding angles
2.2.5- Wait on a time delay

2.3- 'for' loop from 29040 to 24000, do a -180 degrees rotation

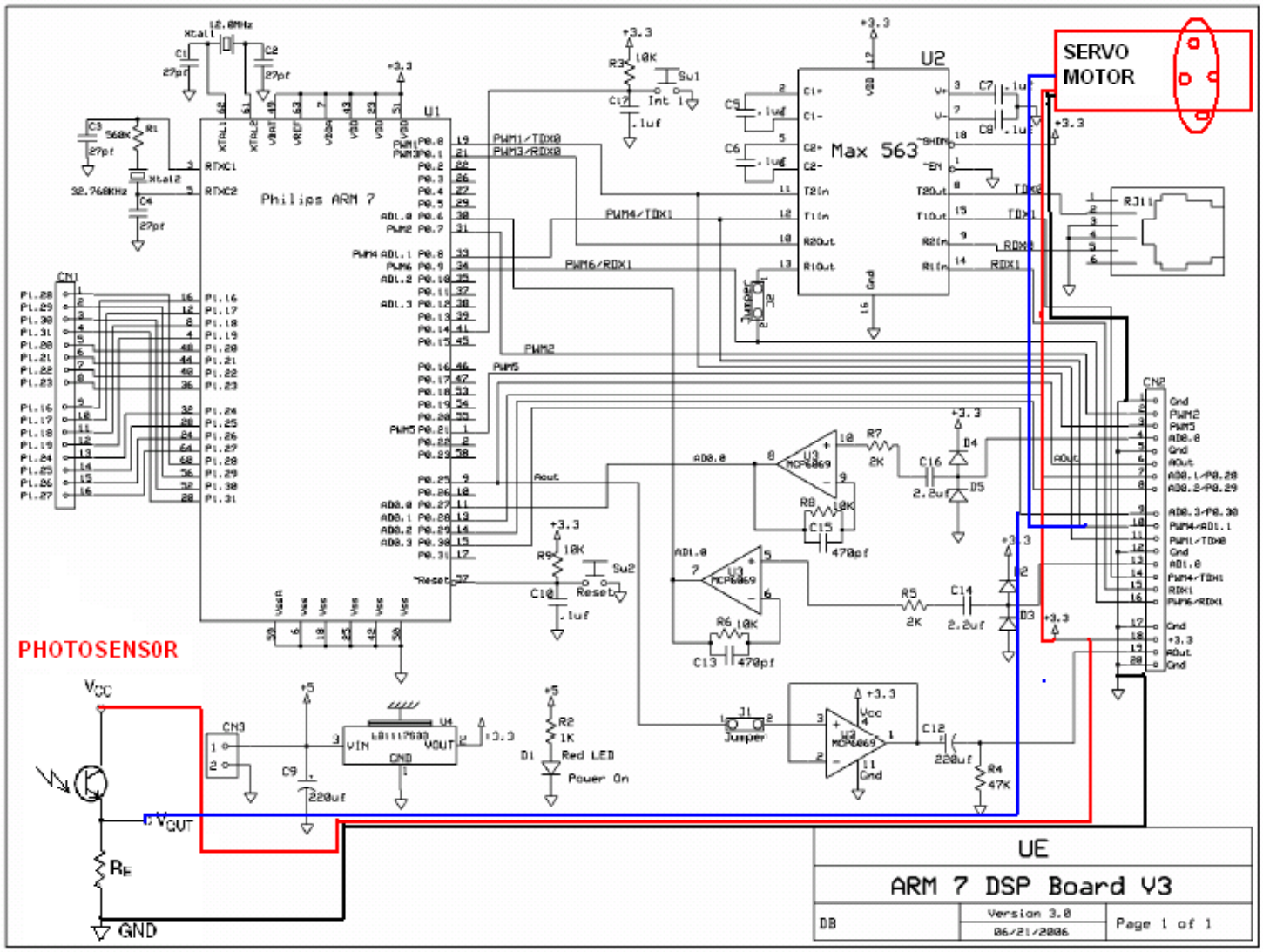
2.3.1- Update PWMMR4 value
2.3.2- Update the latch enable register
2.3.3- Get the A to D converter input voltage
2.3.4- Update the lowest and highest voltage and their corresponding angles
2.3.5- Wait on a time delay

2.4- Display dimmest/brightest light angle and high/low voltages on the HyperTerminal

- **A to D routine design**

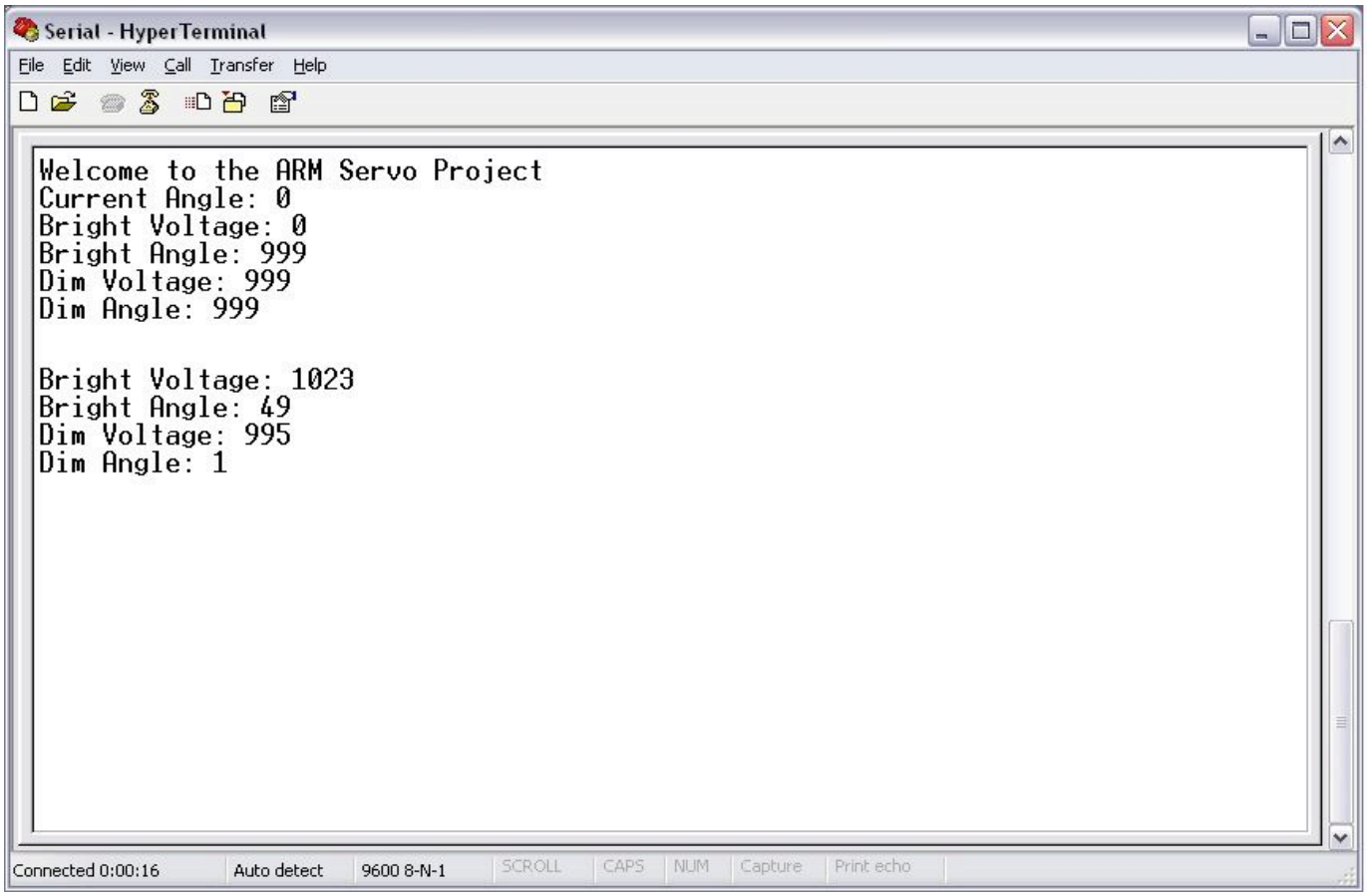
1- Set the Pclk to 30 Mhz
2- Setup A/D:10-bit AIN0 at 4.28MHz software controlled
3- Start A/D Conversion
4- P0.25 set to DA Out, P0.27 set to input AD0.0
5- Read A/D Data Register
6- Wait for the conversion to complete
7- Restart A/D Converter

Hardware design:



Board Schematic

The servomotor is connected to the PW4 and the photo sensor is connected to AD0.3 of the Analog to Digital converter.



Final HyperTerminal Test

Extra features

- The HyperTerminal also shows the highest and lowest voltages outputted by the photo sensor

Conclusion

The device has been tested successfully and operates using a flash-light as a light source.