“Sensor data acquisition routines for AVR based embedded processors”

Shin Hyun Sup

Wireless Internet for the Mobile Enterprise Consortium (WINMEC) http://winmec.ucla.edu/
RFID @ WINMEC Laboratory, http://winmec.ucla.edu/rtl/
420 Westwood Plaza, University of California, Los Angeles, CA 90095

Abstract

This project is to implement the program on the AVR128 that transmits GPS information from PG31 (GPS Machine) to Computer.

What is done in this project are Understanding about NMEA-0183 Protocol, Studying embedded programming for AVR. Through understanding about NMEA-0183 Protocol, I could understand how I can translate the information from GPS Machine. And through studying embedded programming for AVR, I could get the method how I can implement some programs on the AVR.
Introduction

This project is related to GPS. But if we suppose that GPS is a kind of hardware, this project is just to implement a program that controls hardware by AVR128 Board. Actually in the industrial field, there are so many projects to control hardware by using AVR128.

Previous Research

Studying embedded programming for AVR.
And developing, implementing the simple programs.

- Implement the code for controlling LEDs and timer interrupt.
This program counts the numbers between 0 and 255 by LEDs. Then we assume that Turn on is 1, Turn off is 0. I learned the method of controlling port and using timer.

- Implement the code for communication between AVR128 and computer by USART(RS-232).
This program is to communicate between AVR128 Board and PC through USART. This program is used in Final Project to implement to transmit Data each machine (PC, AVR128 Board, GPS).

- Implement the code for accessing the EEPROM in the CPU.
The CPU of AVR128 Board has the EEPROM of 4096 Kb. I studied the method of reading data from EEPROM and writing to EEPROM.

I didn't attach the code or information for this programs. But if you want the code, please send me an E-mail. Because these programs are fundamental for AVR128 programming, when you do some project about AVR128, they can be used. Actually, the code of my final project has implemented by using...
Understanding about GPS

The Global Positioning System (GPS) is a location system based on a constellation of about 24 satellites orbiting the earth at altitudes of approximately 11,000 miles. GPS was developed by the United States Department of Defense (DOD), for its tremendous application as a military locating utility.

I studied about GPS. Especially, I read the document about NMEA-0183 protocol and the manula of PG-31(GPS Machine).

[Project Main content]

Detail description of your project. Present your result, hardware/software setting, result analysis, discussions etc. into sub-sections. If you take pictures, figures, text from other’s work, you need to acknowledge them. Refer to reference using [1].

Software and Hardware Setting

- Software
  Programmers Notepad 2 (The program is a kind of editor that is linked GCC compiler), HyperTerminal (for serial communication)

- Hardware
  Notebook Computer for connecting to AVR128 Board, AVR128 Board, PG31(GPS Machine)
Prototype of functions that I implemented

// Functions for getting GPS Data

void getGPSData(void);  // to Get GPS Data from AVR128 Board through
void ParseGPS(uint8_t buffer[80]); // to Get GPS Data of GGA that has the data of Time, Latitude, // Longitude, Altitude
void ParseGPS_Velocity(uint8_t buffer[80]); // to Get GPS Data of RMC that has the data of Velocity
void printOutGPSData(void );    // to print out GPS Data to PC through Hyper terminal
void initUSART(void);   // to Initialize USART0, USART1

// Functions for UART(in usart_function.c)

void USART_Init( int flag,unsigned int baud ); // to Initialize USART0, USART1

Result analysis

<table>
<thead>
<tr>
<th>Type of data</th>
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<tbody>
<tr>
<td>$GP$ GSA ,A,1,,,,,,,,,,50.0,50.0,50.0*05</td>
</tr>
<tr>
<td>$GP$ GSV ,3,1,12,14,89,000,31,30,42,000,,05,41,000,00,22,35,000,00*7D</td>
</tr>
<tr>
<td>$GP$ GSV ,3,2,12,25,34,000,00,11,15,000,00,09,12,000,00,18,04,000,00*78</td>
</tr>
<tr>
<td>$GP$ GSV ,3,3,12,20,04,000,00,07,03,000,00,24,02,000,,06,-13,000,00*55</td>
</tr>
<tr>
<td>$GP$ RMC ,174820.289,V,0000.0000,N,00000.0000,E,0,00,,290705,,*08</td>
</tr>
<tr>
<td>$GP$ GGA ,174821.289,0000.0000,N,00000.0000,E,000,50.0,0.0,M,0.0,M,0.0,0000*7C</td>
</tr>
<tr>
<td>$GP$ GSA ,A,1,,,,,,,,,,50.0,50.0,50.0*05</td>
</tr>
<tr>
<td>$GP$ RMC ,174821.289,V,0000.0000,N,00000.0000,E,0,00,,290705,,*09</td>
</tr>
</tbody>
</table>

This is whole data from GPS machine (PG-31). I could receive the data by Hyper Terminal and translate by the documbent about NMEA-0183 protocol.
This is the data that I extracted some special data from GPS. Time is made by UTC type. And Latitude, Longitude are the information about the current position. And Altitude is the information about height from sea level. And Velocity means speed.

Discussion

I couldn’t analysis the data as soon as AVR128 Board received, because the data from GPS is transmitted continually. So I made enough space to receive the data from GPS and saved the data in the buffer. And then, I analysised the data by the special characters of ‘$’, ‘,’ ,’#’.

The method of Embedded-based programming is nearly same to the method of general PC based programming. But there are a little differences in the part of variable and memory accessing, so I felt difficult in using them.
This project is my first project that is related with Embedded. But the environment of AVR Development is based of C Language. So it’s not too difficult.

At first time, I had some mistakes, because I was not used to use manual of hardware. But whenever I felt difficulty, Harish helped me. I appreciate his help. Thank you!

**Summary**

Consequently I have done these for this project.

1. **Studying embedded programming for AVR. And developing, implementing the simple programs.**
   - Implement the code for controlling LEDs and timer interrupt.
   - Implement the code for communication between AVR128 and computer by USART(RS-232).
   - Implement the code for accessing the EEPROM in the CPU.

2. **Understanding about GPS**
   - Studying what GPS is.
   - Studying the protocol that GPS uses. NMEA 0183 protocol

3. **Implement the program on the AVR 128 Board that receives data from GPS and transmit to PC**

**Reference**

1. Understanding NMEA-0183
   from [http://pcptpp030.psychologie.uni-regensburge.de/trafficresearch/NMEA0183/index.html](http://pcptpp030.psychologie.uni-regensburge.de/trafficresearch/NMEA0183/index.html)