Conceptual Implementation of A PIC16F8773 to User-Friendly Data Logger

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ABSTRACT

This paper presents the conceptual implementation of a common PIC16F877A microcontroller to a user-friendly data logger for various voltage based monitoring purposes. Construction was solely concentrated on the development of the PIC microcontroller and a simple signal conditioning circuit towards the realization of a fully functional data logger. By utilizing the EEPROM feature available on the pic, data recording could be executed without opting for an external one. Circuit development was successfully assembled and simulated via Proteus VSM simulation software.

Keywords: Data logger, EEPROM, microcontroller, PIC16F877A, Proteus VSM, simulation, interrupt.

INTRODUCTION

Data monitoring provide important information for a comprehensive, accurate picture of the environmental conditions being monitored such as air temperature, humidity, voltage, current, pressure etc [1]. Through recording, automatic data collection could be achieved, thus the introduction of data logger could be made possible. A data logger is an electronic instrument that performs measurement and records it over specific sampling intervals [2].

Data logger constructed from a PIC16F877A microcontroller is low cost and easily available. Some of the available features such as UART, TIMER, INTERRUPT and Electrically Erasable Programmable Read-Only Memory (EEPROM) are effectively employed [3]. Minimal implementation consists of Light Emitting Diode (LED) to indicate data logger status and series of toggle switches for user input.

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SYSTEM DESIGN

System setup was constructed from Proteus VSM as shown in Figure 1. The microcontroller operates from 20 MHz clock frequency and 5V direct current (DC) source. Single analogue channel (AN0) is initialized to read input; future expansion of analogue channel is possible through proper initialization. A potentiometer device is constructed to simulate varying input voltages.
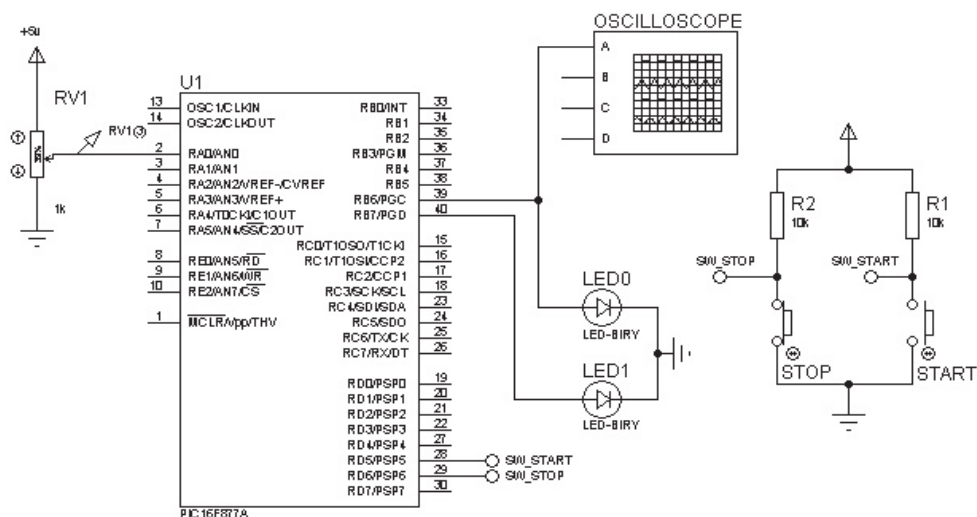

Figure 1: System setup

The Analogue to Digital Converter (ADC) converts actual value from input to a 10 bit digital input. TIMER1 is configured to provide regular sampling interval according to equation 1 [4]. The INTERRUPT routine is enabled for TIMER1. The measured value will be converted to an 8 bit digital value before being stored to EEPROM. Using command in Figure 2 [5], each respective value will be stored upon sampling completion.

$$f_{out} = \frac{f_{osc}}{4 \times PRE \times (65536 - TMR1) \times Count} \tag{1}$$

Whereby f_{out} is the oscillator frequency, PRE is the prescale value, TMR1 is the 16 bit timer 1 value and C_{ount} is the number of count require.

EEPROM_Write(**unsigned int** address, **unsigned short** data);

Figure 2: Writing to EEPROM syntax

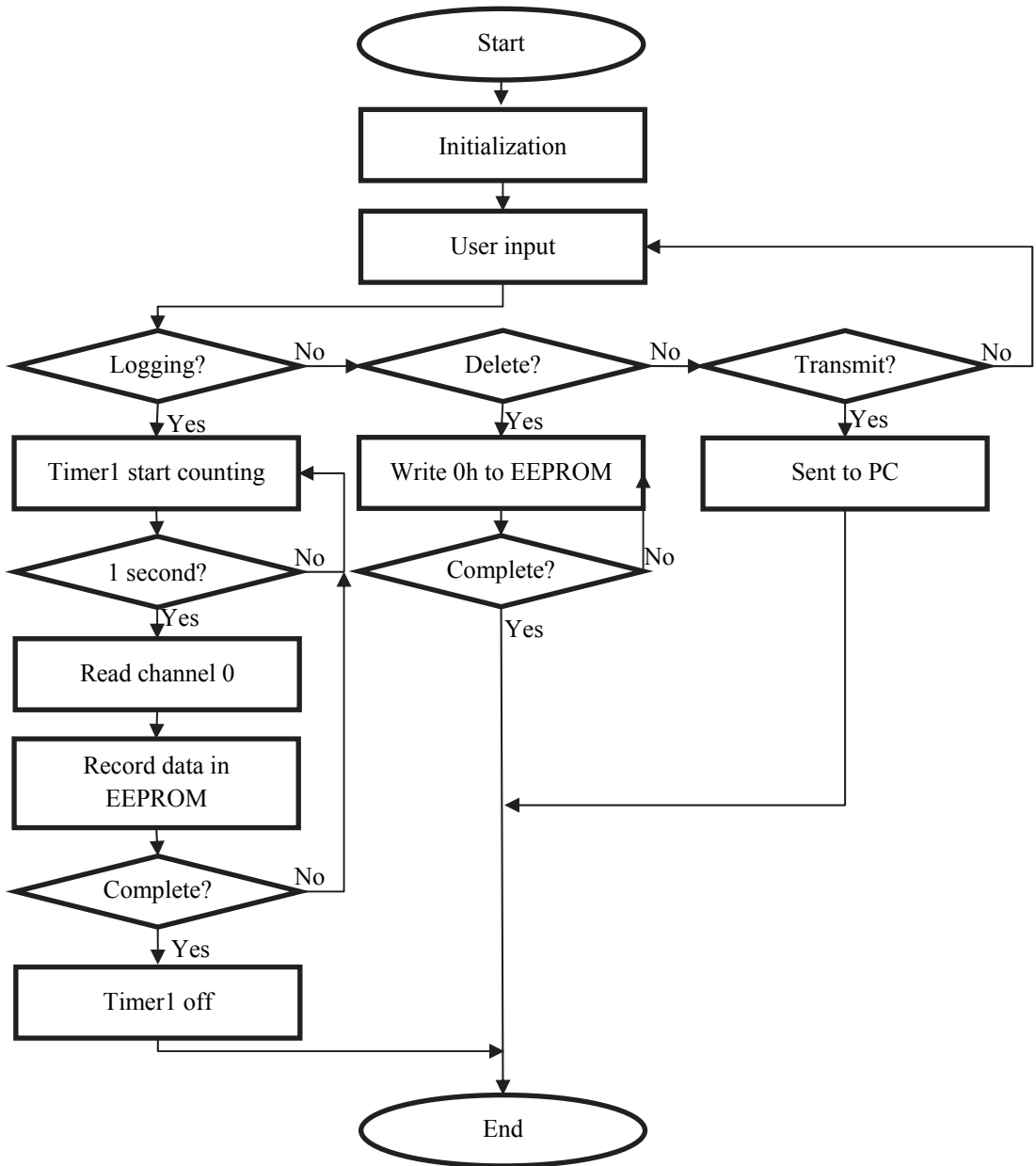System flowchart shown in Figure 3 indicates process flow for data logging software.

Figure 3: Program flowchart

Due to limitation of EEPROM (8 bit per 256 sizes), suitable sampling interval is required to ensure sufficient data logging activity progresses. Bit matching is compulsory since ADC and EEPROM works on different bit level. The use of LEDs contributes toward simple design instead of common Liquid Crystal Display (LCD).

The system initialization configurations are TIMER0, ADC, PORT and INTERRUPT modules. User input from toggle switches enables one of three selections from menu, i.e. delete, logging and transmit. Delete function will clear EEPROM memory, logging perform sampling and transmit sent data to a Personal Computer (PC).

Data logging performs sampling every second, executes bit matching and store in EEPROM. Completing EEPROM size will end the subroutine. Delete function will rewrite EEPROM with 0h until maximum size while data transmission is realized through Universal Asynchronous Receiver-Transmitter (UART) communication.

RESULT

Initial result tested the validity of the INTERRUPT period. 1 second interval is set to the INTERRUPT routine. Figure 4 shows INTERRUPT response captured by channel 1. Distance measured between two successive peaks is at 1sec.
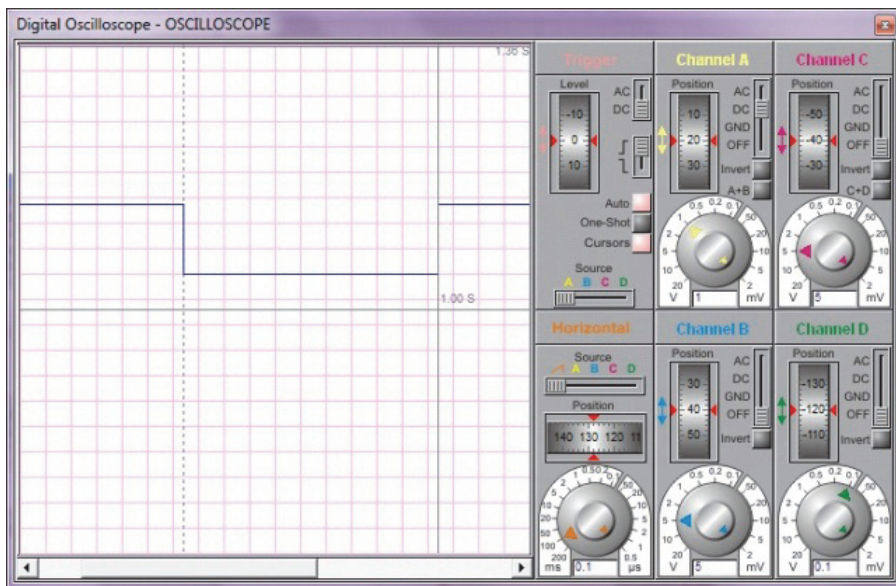

Figure 4: Trigger response for 1 second

Data logging capability was tested through PIC EEPROM memory. In Figure 5, the PIC EEPROM memory window display 63H, which corresponds to 1.95V analogue input.
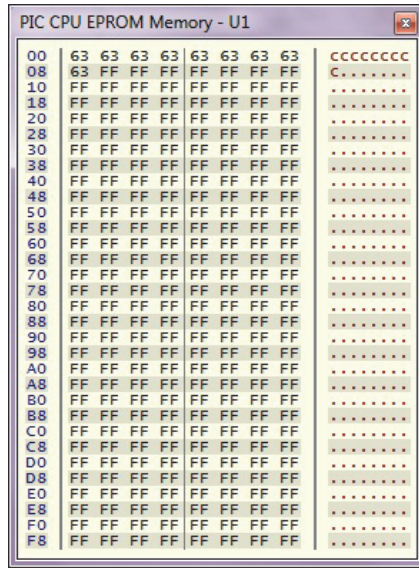

Figure 5: EEPROM debug window

An additional component (a temperature sensor) was added to the existing circuit (Figure 6). Several iterations of varying input were set and its output is recorded. Table 1 which summarized the response obtained.
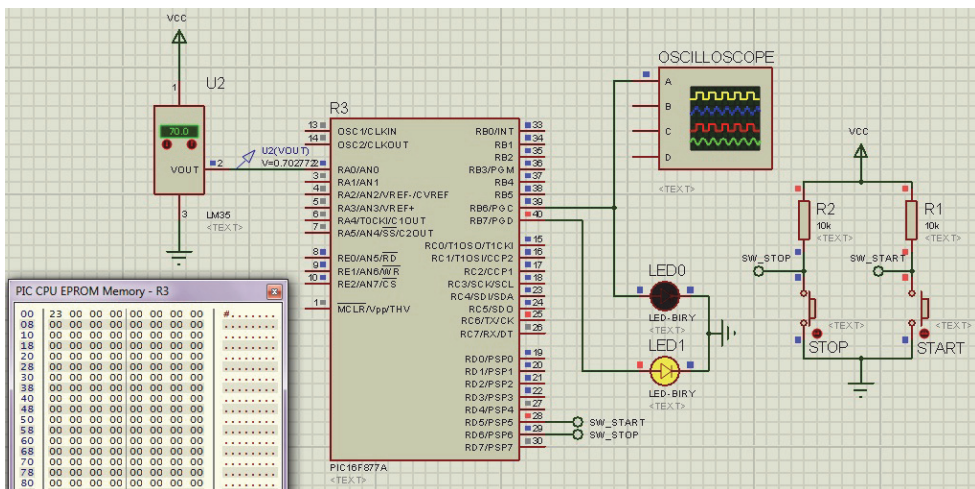

Figure 6: Sensor implementation with EEPROM window setup

Table 1: Simulated sensor response

Temperature (°C)	Voltage (V)	EEPROM (Hex)
10	0.101	05
20	0.202	0A
30	0.302	0F
40	0.402	14
50	0.502	19
60	0.603	1E
70	0.703	23
80	0.803	28

DISCUSSION

The microcontroller configuration for the data logger transformation is simple through the implementation of simulation software. Through simulation, the EEPROM memory will be filled with simulated value from sensor at 1Hz sampling interval. The use of conventional PIC16F877A is easily available and affordable. The utilization of EEPROM feature will enable secure data protection for data logging activity. The transformation would reduce cost, however the limited size of EEPROM could impair long term data recording. The use of external data storage device would be highly favorable for future development. Remote data collection through wireless communication could be advantageous succeeding current prototype.

REFERENCES

[1] Mahendra O, Syamsi D, Ramdan A, Astrid M. (2015). Design and implementation of data storage system using USB flash drive in a microcontroller based data logger. International Conference on Automation, Cognitive Science, Optics, Micro Electro-Mechanical System, and Information Technology (ICACOMIT), 58-62.

[2] Hadiatna F, Hindersah H, Yolanda D, Muhammad Agus T. (2016). Design and implementation of data logger using lossless data compression method for Internet of Things. 2016 6th International Conference on System Engineering and Technology (ICSET),105-8.

[3] Microchip, PIC16F87XA Data Sheet, 2003.

[4] Mazidi, M.A., R.D. McKinlay & D. Causey. (2008). PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18. Pearson Prentice Hall.Timers.

[5]   Verle, M. (2009). PIC Microcontrollers Programming in C: A Complete Guide to Pic Microcontrollers. Mikroelektronika. EEPROM Memory.