RS-232 Based Low Cost Data IO Card

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Abstract

This is the generation of Computer based Automation. Now a days many Electrical Equipments are basically computer controlled. If an equipment is designed which is computer controlled then it is too much easy to change the Set points of the equipments and also to monitor different parameter of the equipment. But computer does not give directly the data from its ports as our required format or configuration. So a Data IO Card is needed to get the computer data in parallel or our required format and also to send external data to computer. So to work with Data IO Card we need to purchase it which around Rs.10 Thousands and also facing problem to found our required configuration. That is why many of the time we don't think about interfacing between electrical equipment and computer. Here we designed a low cost RS-232 based Data IO Card. This can do IN or OUT Data externally as our required format. This paper contains more emphasis in this topic.

Keyword: Computer based Automation, Data IO Card, RS-232 based Data IO Card.

1. Features of the Input Output Card

This Data IO (Input Output) Card has the following features. As per user command through the graphical software the following operation can be done.

- 8-bit Parallels DATA Output
- 8-bit Parallel DATA Input
- 4-Channel Analog DATA Input (10 bit)

- 2-Channel PWM Output (Different Set Point Frequency & Changeable Duty Cycle)

2. Description:

This is basically a micro-controller based Data IO Card. Here used micro-controller is PIC16F877A. This micro-controller is basically communicated with computer through software. The communication is based on RS-232. Basically computer is send data through its RS232 port (COM Port), which is converted through MAX232 and reached to microcontroller port. After getting the data, micro-controller do the necessary depending on the protocol.

Here the software is basically built with Visual basic 6 and the Micro-controller coding is done with Microchip MPLAB.
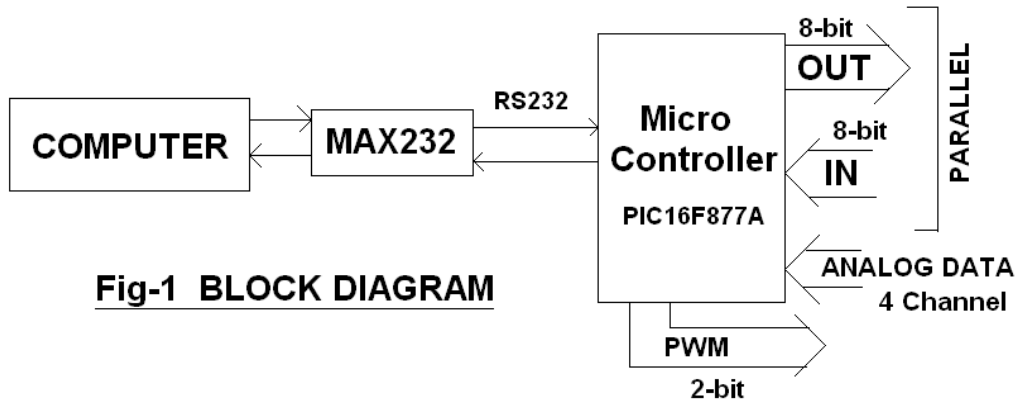
Fig-1 BLOCK DIAGRAM

2.1. Protocol:

The protocol means the Data Format which is used to communicate between microcontroller & computer. Here the protocol consists of one START byte, one CONTROL byte, one DATA byte & one STOP byte for communicating computer to microcontroller.

Computer ⟶ Micro Controller

Field	Byte Value								HEX
START	1	1	1	0	1	0	1	0	EA
CONTROL	1	0	C5	C4	C3	C2	C1	C0	-------
DATA	D7	D6	D5	D4	D3	D2	D1	D0	-------
STOP	0	1	0	1	0	0	1	1	53

CONTROL Value (Lower Six Bit)						Mode Description
C5	C4	C3	C2	C1	C0	
1	1	X	X	X	X	8-bit Parallel Data OUT Mode
1	0	0	1	X	X	Request for Data Input of 8-bit Parallel IN
1	0	1	0	D1	D0	Request Analog Data Input, D1, D0 is the Channel Value
0	1	0	D2	D1	D0	PWM Duty Cycle Data Out, D2 is the PWM Pin, D1, D0 is the Lower 2 bit of Duty Cycle Data & other 8-bit is the DATA byte
0	1	1	D2	X	X	PWM Time Period Data Out, D2 is the PWM Pin

X= Don't Care

After first two byte Micro-controller acknowledge by sending a single byte & after completion of STOP byte micro-controller send a byte for acknowledgement. In Request for Data Input Mode this acknowledgement bytes are used as Input DATA Bit as well as acknowledge bits. There should be a time-out value.

2.1.1. Parallel DATA OUT / IN
After getting the coded value from computer micro-controller decode it and SET to its PORT and the PORT will latched with new value. After getting new value from computer it will be changed otherwise stay with previous value.

After getting the DATA IN request micro-controller process the request and send the Parallel DATA from its PORT to computer.

2.1.2. Analog DATA Sense
The micro-controller contains 8-channel 10-bit ADC, among which 4-channel is used. When micro-controller gets the request for Analog DATA Input, micro-controller receive the Analog DATA from its PORT depending on the channel value coming from computer. After that it will be send to computer.

$$\text{Resolution} = \frac{1}{1023} \times \text{Maximum Vol for which designed}$$

2.1.3. PWM Generation
PWM means Pulse Width Modulation. Here micro-controller can generate PWM with given Time-period as well as given Duty Cycle. That is both frequency & Duty cycle is changeable. Depending on computer given Set point these both are changed. This duty cycle & Time-period does not depend upon loop delay or any other instruction cycle related delay.

$$\text{Max Resolution of Duty Cycle} = \frac{1}{1023} \times 100\%$$

3. Cost Analysis: -

Component Name	Approx (Rs.)
PIC16F877A	160
MAX232	20
PCB	100
IC Socket (2pcs)	20
COM Port Cable (2m)	80
Others	100
Total	480

4. Applications: -

1. Parallel OUT Port can be used as Different Computer Control Load Switching.
2. Parallel IN Port can be used as Load ON/OFF Sensing by current sensing (CT method). Also to sense different Circuit Breaker's make brake status, Isolator status in substations it can be used.
3. PWM pin can be used as computer control separately excited DC motor speed control or Dimming Control of CFL with a special type of Ballast.
4. Analog DATA Sensing is much important because by its different types of analog data we can monitor in computer. E.g. Speed of a Motor by Speed to voltage transducer, any signal Sampling etc.

5. One Application of Computerized Load Switching:-

In the Laboratory we done different work with this Card, one of which is computerized Load switching. Here six 12V relay with optical isolation between Parallel OUT Port & relay Coil are used. Among 8-bit we use here 6-bit for six relay signal. Some pictures are given below.
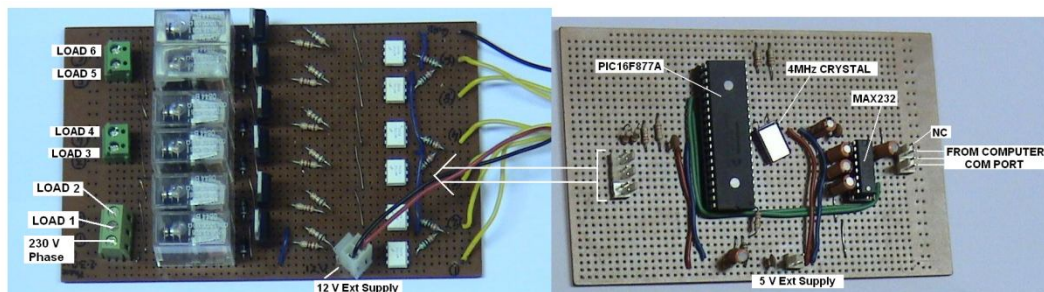

Fig-2 Prototype of the Load Switching Circuit with PC interfacing circuit
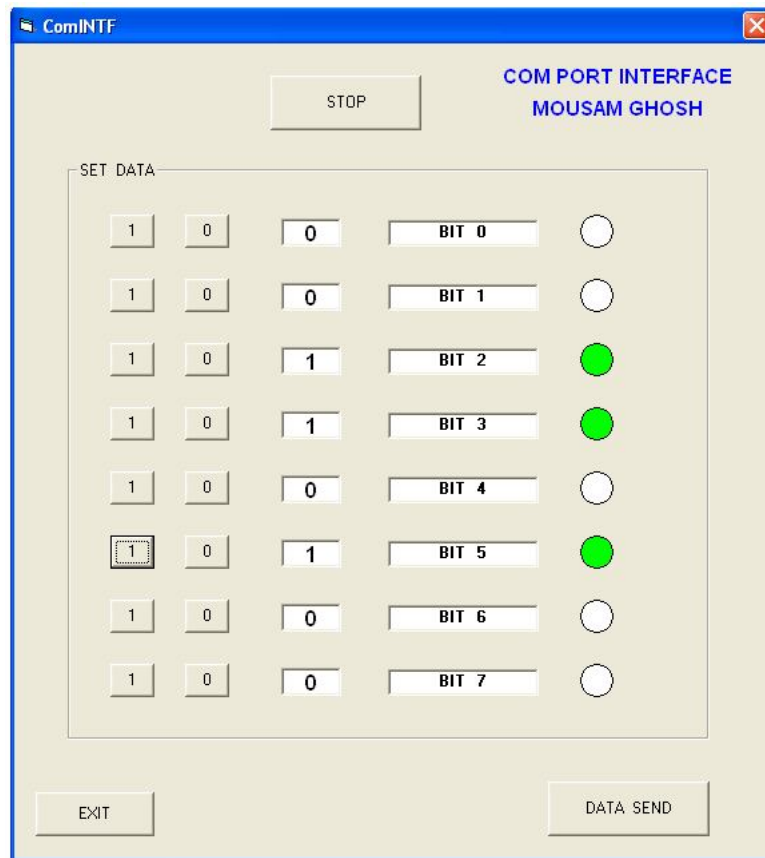
Fig-3 8-bit Parallel DATA OUT Software (developed in Visual Basic 6.0)

This software is only for RS232 (COM Port) based Parallel DATA OUT. This Software is generates code depending on user & transmit to micro-controller board (Fig-2 right hand picture) & after decoding micro-controller control the Relays. If relay operate the switching is done. If we connect any load to a particular pin & if by software we ON (1) that bit then Load will get Power & remains ON. It works properly.

6. Flow Chart: -
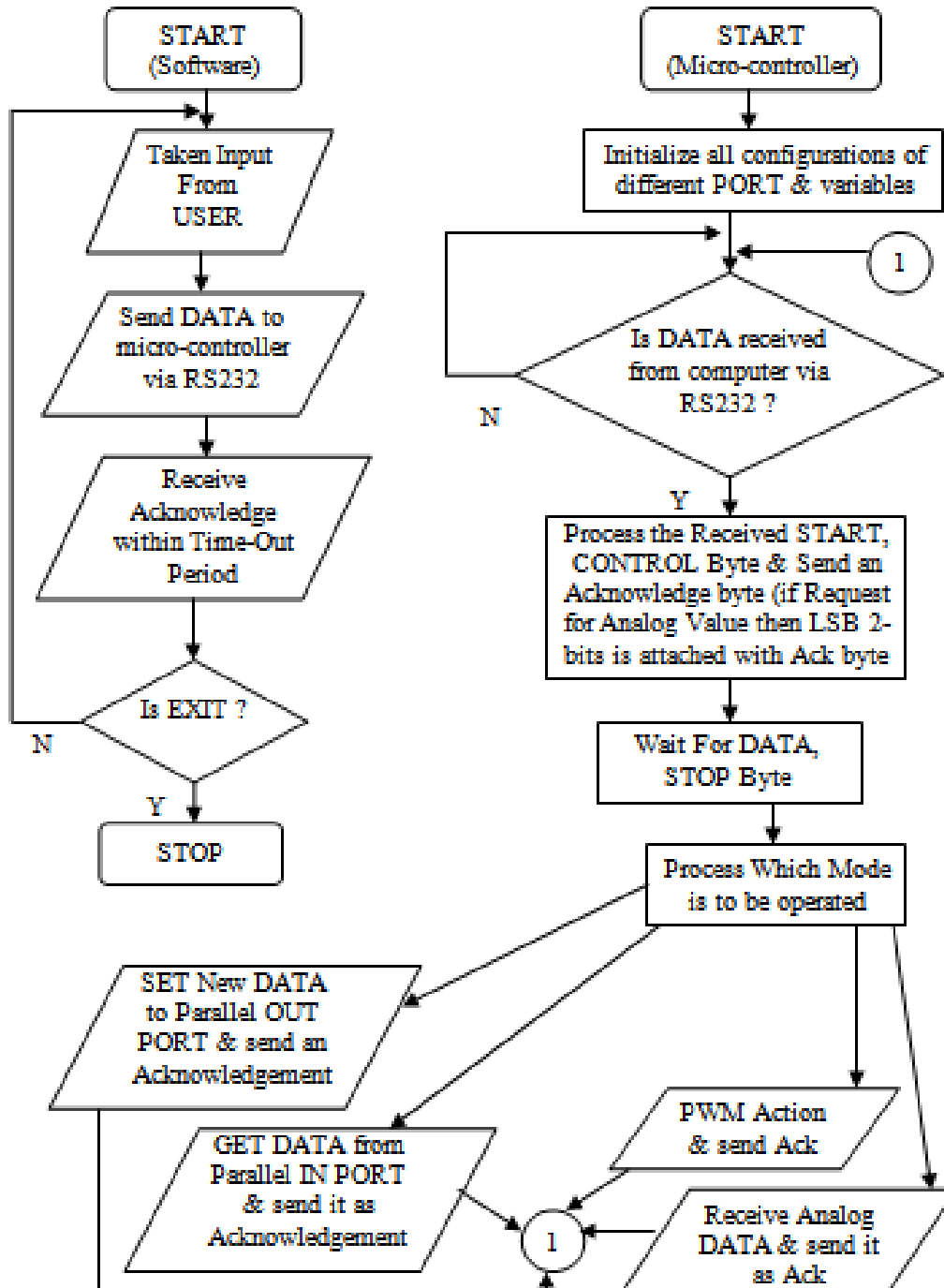
Comment:-

With above design & protocol all the features are working properly. This

design is much reliable because of microcontroller internal timer, the PWM time-period & duty cycle does not fluctuates with instruction cycle delay or any loop delay and the material cost of this project is around Rs.500 which is quite reasonable. It is better to put isolation when interfacing with power line. This Data IO card is very much useful to control different external device from computer.

References:-

[1] M. Smolnikar and M. Mohorcic, (2008) "A Framework for Developing a Microchip PIC Microcontroller Based Applications", Issue 2, Volume 5, February 2008, WSEAS TRANSACTIONS on ADVANCES in ENGINEERING EDUCATION. ISSN: 1790-1979.

[2] M.M. Haque, M.K. Hossain, M.M. Ali and M.R.I. Sheikh, (2011) "Microcontroller Based Single Phase Digital Prepaid Energy Meter for Improved Metering and Billing System", International Journal of Power Electronics and Drive System (IJPEDS) Vol.1, No.2, December 2011, pp. 139~147. ISSN: 2088-8694.

[3] K.K. Reddy, P.G. Jagadeesh, and S.V. Reddy, (2011) "TRAFFIC SIGNALS GENERATION WITH BICOLOR LEDS USING PIC 18F SERIES MICROCONTROLLER", International Journal of Embedded Systems and Applications (IJESA) Vol.1, No.2, December 2011.

[4] X. Wang and W. Guo, (2009) "The Design of RS232 and CAN Protocol Converter Based on PIC MCU", Computer and Information Science, www.ccsenet.org/journal.html, Vol.2, No.-3, August 2009.

[5] S.C. Hsiung, (2007) "The Use of PIC Microcontrollers in Multiple DC Motors Control Applications", Journal of Industrial Technology, Volume 23, Number 3 - July 2007 through September 2007.

Biography

Mousam Ghosh, obtained B.Tech degree in Electrical Engineering From Jalpaiguri Govt. Engineering College and ME degree in Illumination Engineering From Jadavpur University. Presently working as a Trainee Officer (Technical) in West Bengal Financial Corporation, West Bengal, India.

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