

HIGHER TECHNICAL INSTITUTE

NICOSIA - CYPRUS

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN OF A LOW COST STANDALONE DATA
LOGGER FOR A VENTILATOR

E. 1420

BY

CHAMATSOS IOANNIS

JUNE 2007

HIGHER TECHNICAL INSTITUTE

NICOSIA-CYPRUS

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN OF A LOW COST STANDALONE DATA LOGGER FOR A VENTILATOR

E.1420

BY

CHAMATSOS IOANNIS

JUNE 2007

HIGHER TECHNICAL INSTITUTE	PROJECT NO
	3714

DESIGN A LOW COT STANDALONE DATA LOGGER FOR A VENTILATOR

This project is submitted in partial fulfillment requirements for
award of the

DIPLOMA IN ELECTRICAL ENGINEERING

of the

HIGHER TECHNICAL INSTITUTE

E.1420

Project Supervisors:

1. Mr Sotos Voskarides, Lecture in Electronics Engineering, Higher Technical Institute
2. Dr Theodoros Kyprianou, Intensivist, Head of Nicosia New General Hospital ICU
3. Mr George Panayi, PhD candidate in Electronics Engineering, Intensive Care Forum

Designed By:
CHAMATSOS IOANNIS

June 2007

HIGHER TECHNICAL INSTITUTE	PROJECT NO
	3714

LIST OF CONTENTS

ACKNOWLEDGEMENTS.....	i
CHAPTER 1	1
Introduction	1
CHAPTER 2	5
Universal Asynchronous Receiver/Transmitter (UART).....	5
2.1 Definition.....	5
2.2 How it works	5
2.3 Performance.....	6
CHAPTER 3	7
Universal Serial Bus (USB)	7
3.1 Definition.....	7
3.2 Applications.....	7
3.3 How it works	7
3.4 Transfer speed	8
3.5 USB Features.....	8
3.6 SPECIFICATION	10
CHAPTER 4	11
Serial Peripheral Interface Bus (SPI)	11
4.1 Definition.....	11
4.2 Applications.....	11
4.3 Advantages	11
4.4 Disadvantages.....	12
4.5 How it works	12
CHAPTER 5	14
Ethernet RS-232	14
5.1 Definition.....	14
5.2 How it works	14
5.3 Applications.....	14
5.4 Limitations of the standard.....	15
5.5 Voltage levels	16
5.6 Connection Types.....	16
5.6.1 “DB-9”.....	17
5.6.2 DB-25	18
5.7 Pinouts (DTE relative).....	20
5.7.1 DCD (Data Carrier Detect).....	20
5.7.2 RX (Receive Data)	20
5.7.3 TX (Transmit Data).....	21
5.7.4 DTR (Data Terminal Ready).....	21
5.7.5 GND (Signal Ground)	21
5.7.6 DSR (Data Set Ready).....	22
5.7.7 RTS (Request To Send).....	22
5.7.8 CTS (Clear To Send).....	22
5.7.9 RI (Ring Indicator)	22
5.7.10 Other RS-232 Pins.....	23
CHAPTER 6.....	24

Wi-Fi	24
6.1 Definition.....	24
6.2 Applications.....	24
6.3 How it works	24
6.4 Advantages	25
6.5 Disadvantages.....	26
CHAPTER 7.....	28
Hardware	28
7.1 Main Idea.....	28
7.2 Main characteristics of CC2500 (Wi-Fi Transvient).....	30
7.2.1 Key Features.....	30
7.2.2 Circuit Description	32
7.3 Main characteristics of PIC 16F877.....	34
7.4 The board circuit	35
7.5 Pinout.....	36
7.6 PCB design.....	37
CHAPTER 8.....	40
Conclusions	40

Appendix A: Data sheets of PIC 16F877

Appendix B: Data sheets of Wireless Transceiver CC2500

Appendix D: Data sheets of MAX-232

LIST OF FIGURES

Figure 1a	Puritan Bennett 840 Ventilator.....	1
Figure 1b	Bronchi, Bronchial Tree and Lungs.....	3
Figure 3.5.9	Inside a USB cable.....	9
Figure 4.5	SPI bus:single master and three slaves.....	13
Figure 5.6.1a	The female DB-9 connector.....	17
Figure 5.6.1b	The male DB-9 connector.....	17
Figure 5.6.2a	The female DB-25 connector.....	18
Figure 5.6.2b	The male DB-25 connector.....	18
Figure 5.6.3	Wiring pins numbering.....	19
Table 5.7	Pinout.....	20
Figure 7.1a	Connection between data logger and computer.....	28
Figure 7.1b	Ventilator side	29
Figure 7.1c	Computer side	29
Figure 7.2.2a	CC2500 simplified block diagram.....	32
Figure 7.2.2b	CC2500 circuit.....	33
Figure 7.2.2c	CC2500 components list.....	33
Figure 7.3	Main characteristics of PIC16F877.....	34
Figure 7.4	Board Circuit.....	35
Table 7.5	Pinout.....	36
Figure 7.6a	PCB design front view.....	37
Figure 7.6b	PCB design back view.....	38
Figure 7.6c	PCB design	39

ACKNOWLEDGEMENTS

I would like to express my honest thanks to all the academic staff of H.T.I who help me throughout my project work and especially my project supervisor Mr. S. Voskarides, Dr. T. Kyprianou and Mr. G. Panayi.

Also special thanks to all my friends who have been there for me and especially I would like to thank my family for its invaluable support and understanding.

CHAPTER 1

Introduction

The objective of this project was to design and manufacture a low cost, standalone data logger that will collect data from the Puritan Bennett 840 ventilator. The system should consist of a board offering facilities for connection with the computer through the USB and with the Puritan Bennett 840 ventilator through an RS-232. The connection between the PC and the Puritan Bennett 840 ventilator will be wireless.

The Puritan Bennett 840 Ventilator System ventilators is responsive to patients and offers superior comfort, delivering sensitive, precise breaths to critically ill neonatal through adult patients.

Patients are usually placed on a ventilator because of a medical problem that makes it hard for them to breathe well on their own. While on the ventilator, the body is able to rest so that it can heal. The ventilator can help with breathing or totally breathe for the patient



Figure 1a Puritan Bennett 840 Ventilator

The ventilator is a life supporting device for providing mechanical ventilation to patients and it is used in the Intensive Care Unit (ICU). Furthermore due to its monitoring capabilities it provides data about the physiological parameters of the lungs which are extremely important for monitoring the status of the lungs.