DIGITAL INSTRUMENT DISPLAY FOR CARS

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Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer
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"I admit that this is done by myself except the discussion and extracts taken from other sources that I explained each in detail."

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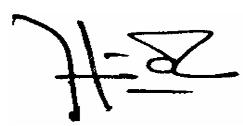
Signature : 

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Date : 27 April 2007

DEDICATION

To my parents, family members, friends and all which involved;

My all times beloved.

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ABSTRACT

The Digital Instrument Display for Cars is based on a PIC microcontroller. This project converts the analogue instruments in cars to a digital display. It is suitable for use with fuel gauges, oil pressure gauges or temperature gauges. It is designed to operate with any sensor or sender unit which varies its resistance or voltage signal output and display the result on a 3-digit LED readout. Basically, it is ideal for use with sender units that have relatively slow changing values. In operation, the unit can be calibrated so that the display will show any value in the range from -99 through to 999. The decimal point can also be placed in one of two positions, so that the values can be from -.99 to 99.9. In addition, the unit can be calibrated to display metric or imperial units. The Digital Instrument Display is calibrated at two values and the instrument calculates the remaining values from these in a linear fashion. For example, if the unit is to be used as a fuel gauge, it is best calibrated when the fuel tank is full and then calibrated when the tank is close to empty. The display will then subsequently be able to show the remaining fuel in the tank over the complete range from full to empty.

ABSTRAK

Alat Paparan Digital Untuk Kereta ini berasaskan pada pengawal mikro PIC. Projek ini menukar alatan analog dalam kereta kepada paparan digital. Ianya sesuai digunakan dengan pengukur minyak, pengukur tekanan minyak atau pun pengukur suhu. Ianya direka untuk beroperasi dengan sebarang sensor atau unit penghantar yang berbeza kerintangannya atau isyarat keluaran voltan dan hasilnya dipaparkan pada tiga digit paparan 7 ruas. Pada asasnya, ianya sesuai digunakan dengan unit penghantar yang mempunyai nilai perubahan relatif yang perlahan. Pada operasinya, unit boleh dikalibrasi untuk membolehkan paparan memaparkan sebarang nilai dalam linkungan -99 sehingga 999. Titik perpuluhan juga boleh diletakkan pada satu atau dua tempat, menjadikan nilai dari -.99 sehingga 99.9. Tambahan pula, unit boleh dikalibrasi untuk paparan metric atau unit imperial. Alatan Paparan Digital dikalibrasi pada dua nilai dan alat ini mengira nilai baki dalam bentuk linear. Contohnya, jika unit digunakan sebagai pengukur minyak, kalibrasi elok dilakukan semasa tangki minyak penuh dan menghampiri kosong. Paparan berikutnya akan memaparkan baki minyak dalam tangki dalam linkungan dari penuh kepada kosong.

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LIST OF ABBREVIATIONS

PIC	-	Peripheral Interface Controller
PCB	-	Printed Circuit Board
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
ADC	-	Analog To Digital Converter
PWM	-	Pulse Width Modulation
BCD	-	Binary Code Decimal
SAR	-	Successive-Approximation Register
RAM	-	Random Access Memory
CPU	-	Central Processing Unit
SMD	-	Surface Mount Devices
DIP	-	Dual In Package
Dp	-	Decimal Point
POV	-	Persistance Of Vision
PC	-	Personal Computer
RISC	-	Reduce Instruction Set Computer
ICSP	-	In-Circuit Serial Programming
POR	-	Power-on Reset
PWRT	-	Power-up Timer
OST	-	Oscillator Start-up Timer
WDT	-	Watchdog Timer
ASM	-	Assembly Language
DC	-	Direct Current
REG	-	Regulator

REF	-	Reference
IC	-	Integrated Circuit
GND	-	Ground
LSB	-	Less Significant Bit
MSB	-	More Significant Bit

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CHAPTER I

INTRODUCTION

1.1 Introduction Of The Project

Most cars have analogue readouts for displaying fuel level and engine temperature. The oil pressure is either shown on an analogue gauge or more commonly, there is no gauge but just an "idiot" warning light. There is nothing wrong with analogue gauges. Some drivers would rather have these outputs displayed in digital format. That is where this Digital Instrument Display comes in.

The Digital Instrument Display for Cars is based on a PIC microcontroller. This project converts the analogue instruments in cars to a digital display. It is suitable for use with fuel gauges, oil pressure gauges or temperature gauges in cars. It is designed to operate with any sensor or sender unit which varies its resistance or voltage signal output due to changes in input. The result is displayed on 3-digit LED readout. Basically, it is ideal for use with sender units that have relatively slow changing values. In operation, the unit can be calibrated so that the display will show any value in the range from -99 through to 999. The decimal point can also be placed in one of two positions, so that the values can be from -.99 to 99.9. In addition, the unit can be calibrated to display metric or imperial units. Fuel and temperature gauges do not usually show precise values. Instead, they give a general indication of how things are going. As an example, remaining fuel level somewhere between full and half-empty or temperature midway between hot and cold. By contrast, it can calibrate this digital display unit to show the actual values. The Digital Instrument Display is calibrated at two values and the instrument calculates the remaining values from these in a linear fashion. For example, if the unit is to be used as a fuel gauge, it is best calibrated when the fuel tank is full and then calibrated when the tank is close to empty. The display will then subsequently be able to show the remaining fuel in the tank over the complete range from full to empty.

1.2 Project Objective

To design the Digital Instrument Display circuit that can:

- Convert the analogue display in cars to a digital display.

In order to ensure that the project objectives are met:

- To be able to program Peripheral Interface Controller (PIC) microcontroller:
  - As an analog to digital converter
  - To display the digital value by BCD 7-segment.

1.3 Problem Statement

Most cars have analogue readouts for displaying fuel level and engine temperature. Similarly, the oil pressure is either shown on an analogue gauge or more commonly, there is no gauge and just an “idiot” warning light instead. Of course, there is nothing wrong with analogue gauges, it is just that some drivers would rather have these outputs displayed in digital format. With a digital display, the driver can know more details about the fuel level and engine temperature.

1.4 Scope Of Works

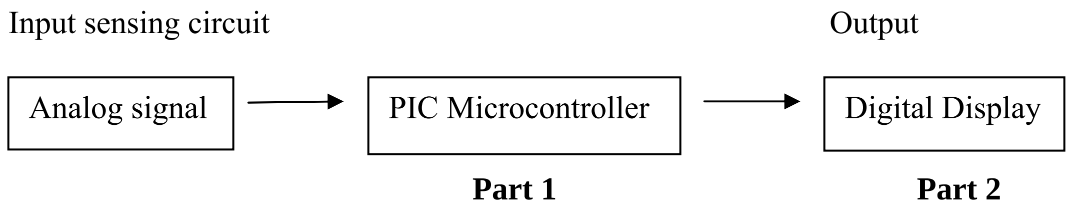

Figure 1.1 : Diagram of process

This project is divided into two parts, the first part is the controller circuit using PIC (Microchip Peripheral Interface Controller). The second part is the digital instrument display circuit. The operation of the product will be controlled by a PIC. For the PIC, program will be written using assembly language and burnt. The digital instrument display circuit will be then be constructed. Testing and calibration on real hardware will be carried out to ensure it is functionally correct.

1.5 Method Of Project

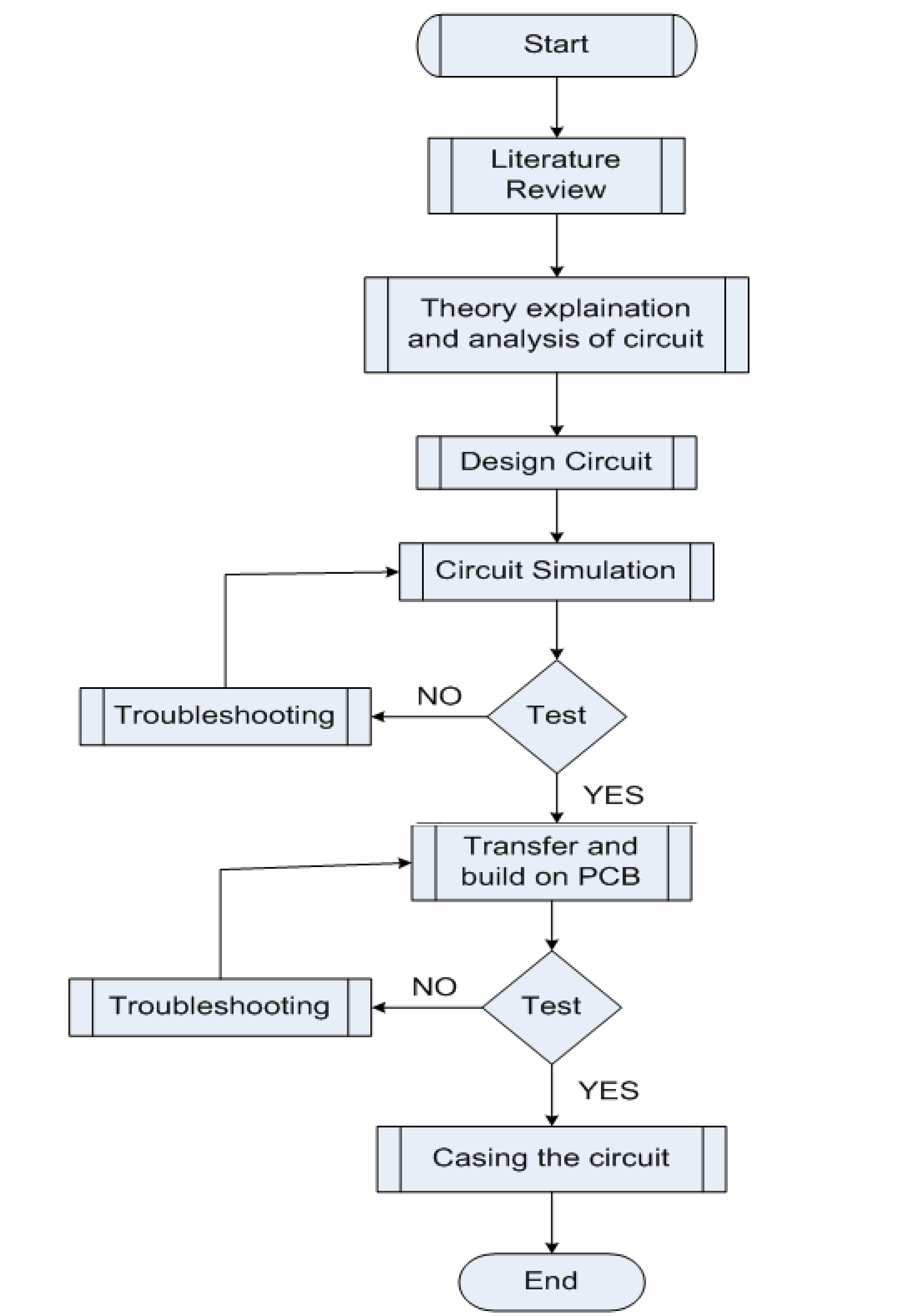

Figure 1.2 : Flow Chart of Brief Methodology

1.6 Thesis Outline

This report is divided into several chapters. They are

I. Introduction

II. Literature Review

III. Project Methodology

IV. Result and Discussion

V. Conclusion and Suggestion

This thesis represent by five chapters. Chapter I will focus on brief introduction of the project carried. The important overview or description including the problem statement, project objectives and project scopes are well emphasized in this part.

Chapter II will be based on the literature review of the project. It is mainly focused on the analog to digital converter, PIC16F84A and about seven-segment display (multiplexing). It also defined the details including PIC programmer.

Chapter III will explain on the concepts, theories and principle used in order to complete the project. This part consists of the methodology and also the information on research, experiment and simulation carried during the project development.

Chapter IV mainly focused on the result and analysis done using the device. All testing and verification result are attached with the aid of figure, table and statistic related to the project.

Chapter V is a complimentary of previous four chapters. It describes on the overall project, discussion and suggestion for the project. All matters arise including the problems and unachieved objectives will be described clearly in this part.

CHAPTER II

LITERATURE REVIEW

2.1 Analog-to-digital Converter

An **analog-to-digital converter** (abbreviated **ADC**, **A/D** or **A to D**) is an electronic circuit that converts continuous signals to discrete digital numbers. Typically, an ADC is an electronic device that converts an input analog voltage to a digital number. The digital output may be using different coding schemes, such as binary and two's complement binary. However, some non-electronic or only partially electronic devices, such as shaft encoders, can also be considered as ADCs.

An ADC inputs an analog electrical signal such as voltage or current and outputs a binary number. In block diagram form, it can be represented as such:

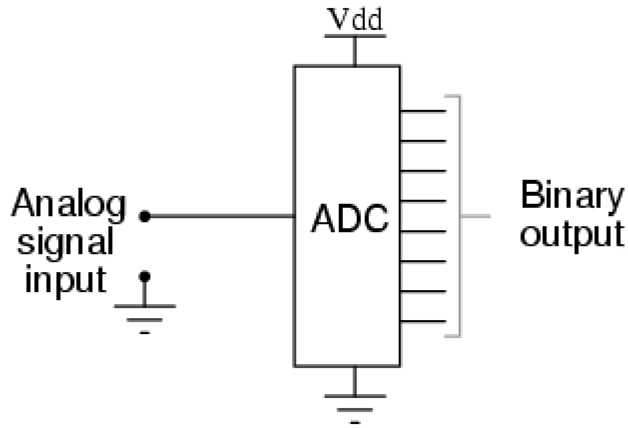

Figure 2.1 : Block Diagram of ADC

2.2 Successive Approximation ADC

The successive-approximation converter is one of the most widely used types of ADC. One method of addressing the digital ramp ADC's shortcomings is the so-called *successive-approximation* ADC. The only change in this design is a very special counter circuit known as a *successive-approximation register*. Instead of counting up in binary sequence, this register counts by trying all values of bits starting with the most-significant bit and finishing at the least-significant bit. Throughout the count process, the register monitors the comparator's output to see if the binary count is less than or greater than the analog signal input, adjusting the bit values accordingly. The way the register counts is identical to the "trial-and-fit" method of decimal-to-binary conversion, whereby different values of bits are tried from MSB to LSB to get a binary number that equals the original decimal number. The advantage to this counting strategy is much faster results.

Without showing the inner workings of the successive-approximation register (SAR), the circuit looks like this: