DIGITAL TACHOMETER AND REVOLUTION COUNTER FOR CAR ENGINE

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Specially dedicated to my beloved family especially my parents and family members.
Last but not least, to my supervisor, my friends and all the UTeM lecturers.

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ABSTRACT

Nowadays, the usage of digital tachometer is rare and revolution counter is non existent due to the fact that these electronic devices are quite expensive in the market. A digital tachometer and revolution counter will be displaying digitally the revolution per minute and total number of engine revolution of a car's engine on the liquid crystal display. The digitally displays are more accurate and precise compared to analogue. A tachometer is a device that measures the rotation speed of a shaft in a car's engine. A revolution counter concept is similar to an odometer where the revolution counter measures the rotation of crankshaft coverage while the odometer measures the distance coverage. The main objective of this project is to design and develop a low cost digital tachometer and revolution counter by using Microchip PIC microcontroller. A car maintenance schedule base on the total number of engine revolution will be proposed in this project as a reference for the driver to do his car maintenance. There are four phases of methodology to complete this project which are literature review, PIC source code development, hardware development and thesis writing. The expected result of this project is that, the circuit will be able to measure and display the revolution per minute readings and total number of engine revolution digitally on the liquid crystal display. Hopefully, this project can be implemented in our national automotive industry.

ABSTRAK

Pada masa kini, penggunaan takometer digit amat terbatas dan pembilang putaran masih belum direka disebabkan faktor harga perkakasan elektronik terbabit amat mahal di dalam pasaran. Secara asasnya, takometer dan pembilang putaran memaparkan bacaan putaran per minit dan jumlah putaran engkol enjin kereta secara digit di paparan hablur cecair. Projek ini memberikan bacaan digit yang tepat berbanding dengan bacaan analog. Konsep mengira putaran adalah sama seperti odometer di mana pengiraan putaran adalah mengukur putaran engkol manakala odometer pula adalah mengukur jarak perjalanan kereta. Objektif utama projek ini ialah mereka bentuk dan membangunkan takometer dan pembilang putaran digit yang murah dengan menggunakan PIC. Satu jadual penyelenggaraan kereta berdasarkan jumlah putaran engkol turut dicadangkan sebagai rujukan yang tepat untuk pemandu-pemandu kereta melakukan penyelenggaraan dan pemeriksaan kereta. Metodologi projek ini dibahagikan kepada empat fasa yang berlainan iaitu kajian latar belakang, membangunkan program untuk PIC, membangunkan litar dan penulisan tesis. Jangkaan hasil untuk projek ini ialah litar takometer dan pembilang putaran digit dapat mengukur putaran engkol dan seterusnya memaparkan bacaaan putaran per minit and jumlah putaran engkol di paparan hablur cecair. Secara amnya diharapkan, projek ini dapat digunakan di dalam industri automotif Malaysia.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

RPM – Revolution per Minute

PIC – Peripheral Interface Controller

PSM – Projek Sarjana Muda

LCD – Liquid Crystal Display

PCB – Printed Circuit Board

IC – Integrated Circuit

LED – Light Emitting Diode

VSM - Virtual System Modelling

DTRC – Digital Tachometer and Revolution Counter

RPS – Revolution per Second

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A tachometer is an instrument that measures the rotation speed of a shaft or disk, as in a motor or other machine. The device usually displays the revolutions per minute (RPM) on a calibrated analog dial, but digital displays are increasingly common. The term comes from Greek Ταχος, tachos, "speed", and metron, "to measure"[1]. Basically, the purpose of digital tachometer can assist the driver in selecting appropriate throttle and gear settings for driving conditions. Thus, the prolonged use at high speeds may cause excessive wear and the other damages to engine. A revolution counter is an electronic instrument that measures the average of each of rotation shaft in car engine. The device usually displays the total number of engine revolutions in revolution (Rev).

The purpose of digital revolution counter is more as a reference to the engine lifetime and do car maintenance schedule. The car maintenance schedule such as changing the spark plugs, timing belt, engine oil, gear oil, oil filter and the others was proposed based on the total number of engine revolution recorded. These two instruments were implemented and also combined together in one system using the Microchip PIC microcontroller. The digital tachometer and revolution counter will give more accurate reading compared to analogue reading. The usage of digital tachometer is rare because the price is quit expensive while digital revolution counter is non existent. So, the purpose of this project is to build a low cost and efficient digital tachometer and revolution counter by using Microchip PIC Microcontroller.

1.2 PROJECT OBJECTIVES

The main objective of this project is to design and develop a low cost digital tachometer and revolution counter using Microchip PIC Microcontroller. A maintenance schedule will be proposed based on the total number of engine revolution.

1.3 PROBLEM STATEMENT

Nowadays, everybody wants good quality equipment but the cost must be low. In the market, the use of digital tachometer is rare and revolution counter is non existent. Car users usually refer to the odometer to do their car maintenance. Basically, the odometer measures the distance coverage only. So, the true condition of the lubrication oil, spark plugs, oil filter and the others do not often relate to distance coverage. This situation can be compared to city and country driving which obviously requires the former one to change much earlier in time the engine oil, spark plugs, oil filter and others.

1.4 SCOPE OF WORK

In this project, there are three scope of work that must be implemented to make sure the project is successful. Firstly, design a low cost circuit by using Microchip PIC microcontroller. Secondly, program the PIC for this project. Thirdly, propose a maintenance schedule for car such as changing engine oil, oil filter, transmission oil, spark plugs and the others.

1.5 SHORT BRIEF OF PROJECT METHODOLOGY

In this PSM I, project methodology is divided into literature review, PIC source code development and hardware design development. The combination of both parts will be added on the PSM II report. The project methodology details are shown in Chapter 3 of this report.

In literature review, all the information regarding this project will be stated such as the type of PIC to use, types of LCD, the operations of electronic tachometer, the operations of crankshaft, the car maintenance schedule and the others.

In the PIC source code development, the PIC source code for this project will be developed by using MPLAB software. The MPLAB software was used to build the source code or program in assembly language.

In the hardware development, the circuit will be simulated in Proteus software. Once the simulation is correct, the circuit will be tested on the breadboard. After that, the circuit will be transferred on the PCB when all the connections on the breadboard are running properly. The LCD is used to display values of RPM and total number of engine revolutions.

1.6 REPORT STRUCTURE

This report consists of five chapters which are Introduction, Literature Review, Methodology, Result and Discussion, and Conclusion and Suggestion.

In Chapter 1 is introduction. It discussed about project background, project objectives, problem statement, scope of work, short brief of project methodology and overview of the remaining chapters.

In Chapter 2 is literature review. It reviews some references from previous project, journals, articles, books and datasheet. All the materials are useful information to this project.

In Chapter 3 is methodology. It discusses the approach to complete this project. This project was divided into two parts which are software development and hardware design. The details of the process for both parts will be presented in this chapter.

In Chapter 4 is result and discussion. It shows the result that had been obtained in this project.

In Chapter 5 is conclusion and suggestion. It concludes the entire project and proposes some future plan for this project.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review is a body of text that aims to review the critical points of current knowledge on a particular topic. This chapter reviews some references from previous projects, journals, articles, books and datasheet. All these information was collected from different sources such as library, internet and product manual. The useful data of this project will be discussed in this chapter. This chapter will study the fundamental theories on an electronic tachometer, the engine revolutions mechanism, the car maintenance schedule, the Microchip PIC microcontroller and others.

2.2 THE OPERATION OF DIGITAL TACHOMETER AND REVOLUTION COUNTER

The signal driving digital tachometer and revolution counter is originate from an ignition coil. An ignition coil is an induction coil in an automobile's ignition systems which transform the battery 12V to the thousand of volts needed to ignite the spark plug [2]. Firstly, the ignition system will produce a high voltage electrical charge and transmits it to the spark plugs via ignition wires. The first electrical charge flows to the distributor. The distributor is to distribute the high voltage from the coil to the cylinders to perform the power stroke or combustion stroke. Thus, the distributor has one wire going in the center and some wires on the number of cylinders such as 4, 6 or 8 wires coming out of it. These ignition wires send the charge to each spark plug. The engine is timed so that only one cylinder receives a spark from the distributor at a time. The ignition system is shown in Figure 2.1.

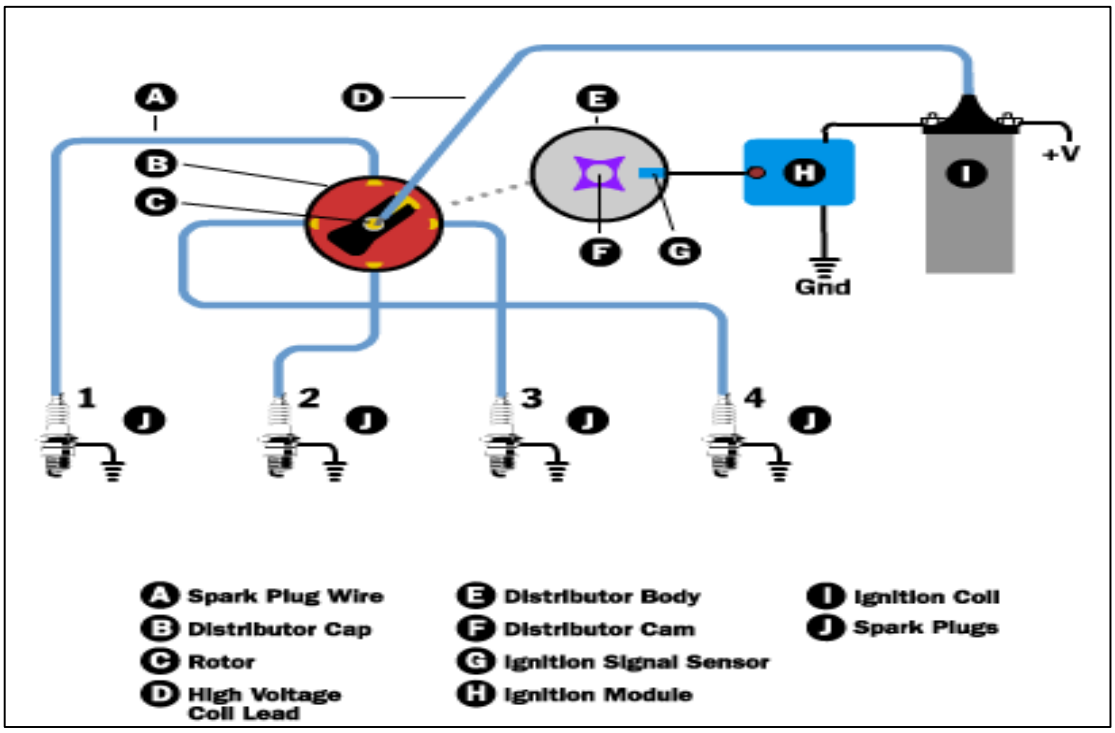

Figure 2.1 The Basic Operation of Ignition System

The sequence spark plugs ignition is called the firing order. The firing order is the order in which combustion is initiated in an internal combustion engine and normally it starts from cylinder number 1. There are various firing orders for different engine layouts as shown Table 2.1[4].

Table 2.1 The Various Firing Order

Number of Cylinder	Firing Order
3	1-3-2
4	1-3-4-2
5	1-2-4-5-3
6	1-5-3-6-2-4

A four stroke engine requires four strokes of the piston which are two up and two down movement. So, one complete combustion cycle of ignition system will make two revolutions of crankshaft. That means one revolution of crankshaft needs 2 pulses of ignitions [5].

2.2.1 ELECTRONIC CONTROL UNIT

In modern car, the digital tachometer and revolution counter get the input signal which is ignition coil signal from the electronic control unit compare to the old car where a tachometer get the signal from contact breaker. An electronic control unit is an embedded system that controls one or more of the electronic systems or subsystems in a vehicle [6]. Normally, an electronic control unit has many control unit such as