POCKET TACHO METER

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DEDICATION

Special dedicated to my beloved family, lecturer, friend and those people who have guided and inspired me throughout my journey of education

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ABSTRACT

As we can see now, the tachometer becomes used full. The infrared tachometer sensor needs only a reflector which have black and white stripe. The motor shaft will be covered with the reflector and the infrared sensor is placed at the distance 1cm from the reflector. The output voltage pulses received from light detector is around 100uV – 10mV. One complete cycle of the voltage pulse mean one revolution of the rotating shaft. This one revolution needs to be counted until a minute to get the angular speed of rev/minute. This signal needs to be amplified and modified so that it can be detected by all standard digital components including microprocessor or microcontroller. A LCD display is used to shows the speed of the motor in value of rev/min.

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LIST OF ABBRE VIATION

I/O	-	Input Output
RAM	-	Random Access Memory
ROM	-	Read Only Memory
PROM	-	Programmable Read Only Memory
EPROM	-	Erasable Programmable Read Only Memory
IC	-	Integrated Circuit
R	-	Resistor
LED	-	Light Emitter Diode
k	-	kilo
V	-	volt
mA	-	mili ampere
LDR	-	Light Dependant Resistor

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CHAPTER 1

INTRODUCTION

1.1 Introduction

High-quality digital tachometers are incorporated into servo, mechatronic, robotic and precision production systems for the calculation of accurate, high-bandwidth, digital velocity information. The M/T-type tachometer and the related constant sample-time digital tachometer (CSDT) have been shown to perform well in many such systems. However, sensor no ideality can introduce very significant errors into the tachometer output. In this paper, it is shown that performance can be greatly improved (i.e., the noise present in the velocity signal significantly reduced) by oversampling the counter values used for velocity calculation. The counting and oversampling operations inherent to the oversampled CSDT (OCSDT) are implemented using a field-programmable gate array (FPGA). The design of the digital circuitry is described in detail, with particular emphasis on the circuits required for implementation and control of the oversampling operation. The FPGA acts as a peripheral device to a digital signal processor (DSP). Besides implementing some division-based calculations to generate a velocity word, the DSP can carry out other measurement and control functions, as required by the overall system. Simulation studies and experimental results are used to highlight the advantages of the over-sampling technique.

Tachometers or rev counters on automobiles, aircraft, and other vehicles show the rate of rotation of the engine's crankshaft, and typically have markings indicating a safe range of rotation speeds. This can assist the driver in selecting appropriate throttle and gear settings for the driving conditions. Prolonged use at high speeds may cause inadequate lubrication, overheating (exceeding capability of the cooling system), exceeding speed capability of sub-parts of the engine (for example spring retracted valves) thus causing excessive wear or permanent damage or failure of engines. This is more applicable to manual transmissions than to automatics. On analogue tachometers, speeds above maximum safe operating speed are typically indicated by an area of the gauge marked in red, giving rise to the expression of "redlining" an engine — revving the engine up to the maximum safe limit. The red zone is superfluous on most modern cars, since their engines typically have a rev limiter which electronically limits engine speed to prevent damage. Diesel engines with traditional mechanical injector systems have an integral governor which prevents over-speeding the engine, so the tachometers in vehicles and machinery fitted with such engines sometimes lack a redline.

In vehicles such as tractors and trucks, the tachometer often has other markings, usually a green arc showing the speed range in which the engine produces maximum torque, which is of prime interest to operators of such vehicles. Tractors fitted with a power take off (PTO) system have tachometers showing the engine speed needed to rotate the PTO at the standardized speed required by most PTO-driven implements. In many countries, tractors are required to have a speedometer for use on a road. To save fitting a second dial, the vehicle's tachometer is often marked with a second scale in units of speed. This scale is only accurate in a certain gear, but since many tractors only have one gear that is practical for use on-road, this is sufficient. Tractors with multiple 'road gears' often have tachometers with more than one speed scale. Aircraft tachometers have a green arc showing the engine's designed cruising speed range.

In older vehicles, the tachometer is driven by the RMS voltage waves from the low tension (LT) side of the ignition coil, while on others (and nearly all diesel engines, which have no ignition system) engine speed is determined by the frequency from the alternator tachometer output. This is a special circuit inside the alternator to convert from rectified sine wave to square wave, and the electrical potential difference is directly proportional to engine speed. Tachometers driven by a rotating cable from a drive unit fitted to the engine (usually on the camshaft) also exist - usually on simple diesel-engine machinery with basic or no electrical systems. On recent EMS found on modern vehicles, the signal for the tachometer is usually generated from an ECU which derives the information from either the crankshaft or camshaft speed sensor.

The taco will measure RPM of an R/C helicopter rotor using a shutter effect by rotating a disc at a known RPM and displaying the result on a LCD screen. The user looks through a “view hole” and attempts to stop the blades with the shutter speed control. When the disc RPM matches the rotor RPM, the rotor will look like it’s not rotating. It’s a very simple concept and works very well for this application. The memory button when pressed will take a “snap shot” of the RPM at that moment and display it on the screen. This project requires some fairly good soldering skills and some fabrication ability is helpful. The purpose of this project is to develop an angular speed detection system using a special Infra-Red sensor (*IR*) where it can detect black and white color and give a small differences voltage signal when the shaft motor was rotating. The black and white color will put at the shaft motor. When the shaft motor is rotated, the emitter IR sensor will emit infrared continuously and detect the color changes depends on setting or fixed time that will be programmed at microcontroller using PIC 16F877A (Programmable Interface Controllers) complier software.

This colors changing will generate a differences voltage. Usually, the microcontroller only recognizes digital input which is 0V and 5V. If the infrared reflected is less, the receiver would probably produce 2V or 3V and microcontroller is unable to deal with these analog values. So, the comparator (LM324) is used to solve this problem. By using the comparator LM324, the output voltage from IR receiver will compare to an input voltage through a variable resistor. This comparator able to compare for both input voltage and generate either 0V or 5V where it can connect to microcontroller. Lastly, the output voltage from microcontroller will display using LCD (*Liquid Crystal Display*) 8 x2LCD screen

1.2 Objectives

There are several objectives that are to be achieved at the end of the project which includes:

i. To design an intelligent system of automatic fish feeder using PIC microcontroller.

ii. To learn about the art of programming in C language.

iii. To combine together all hardware skills, electronic knowledge with some software development in building this project.

iv. To make sure that this tachometer became small and can be used in a small area.

v. To explore the application of infrared sensor at industry.

vi. To investigate a new measurement device of angular speed,

1.3 Problem Statement

The problem in this project is to generating the output in digital value at LCD display where the sensor has detected average 100µA – 10mA .Beside that the speed of rotating motor need to control to make sure the output can be measure depends on the setting time. The project also have improve the design to make it became more flexible in all area.

The screen updates the RPM every 1 second since that's how long it reads the sensor. The longer time to read the sensor, the more accurate the RPM is. There is a trade off due to the math in step 3. If the sensor longer, the resolution goes higher however the screen update gets longer which can be a pain. If you read the sensor shorter for example perhaps it's only .5 seconds, then you get a fast screen update but the RPM is low resolution which causes the RPM to count by 50's. I tried to get the best of both worlds. Reading the sensor for 1.5 seconds, the RPM will count by 20's which is pretty good. It's stable and does not jump all over the place.

The reason I used three slots instead of one was to slow down the "real" RPM of the wheel. I tried it with one slot and the wheel had to physically spin at 3000 RPM to read a 3000RPM heli rotor. This made the tach vibrate and it was very noisy. Three slots caused the wheel to spin at 1/3rd of its original speed and it was very quiet. When the tach is reading a rotor RPM of 3000, the wheel inside the tach is actually spinning at 1000RPM.

1.4 Scope of Work

As to ensure the completion of project achieves the stated objectives, the project shall be completed within these scopes:

i. To built an IFF system that is suitable for;

ii. The input power used 12V-15 V

iii. The rotation motor speed will measured aroud 100-2000 rev/m and ± 10% tolerence.

iv. The out put will be dispay in LCD (2x8 display)

v. The input current that supply to infrared sensor is around 100µA – 10mA

CHAPTER 2

LITERATURE REVIEW

2.1Introduction

This chapter is discussing about previous research in tachometer related on the project. There are two previous projects that will be discussed in this chapter.

2.2 Tachometer (toothed rotor tachometer detection.

The infrareds sensor is widely used in industries for scanning bar code and detecting material. The research in measuring position recently becomes more important. The measurement of position for rotating and linearly translating parts is a key requirement in automation. The instrument that measuring rotating part called tachometer. There is lots of tachometer with different type of sensing technique but they have disadvantages. Among disadvantages are managing the sensor required time and lack of precision in measurement. The following cases are about tachometer and their disadvantages.

A tachometer is a device to measure speed of rotating shaft in the angular speed which mean in revolutions per minute. The tachometers are widely used in industries to measured angular speed in generator and motor. There are many types of technique to use to sense the speed of rotating shaft. For example, toothed – rotor tachometer which used several ferromagnetic tooth on its rotor. Then, a permanent magnet with a coil wrapped around it, is placed in the motor stator. The changing of magnetic field strength will induce a voltage. For every rotor tooth one voltage pulse id\s produced. The input voltage pulse will be converted into frequency as an output signal. The toothed – rotor tachometer has disadvantage because it's fix to the rotor of the motor and reassemble the motor required.

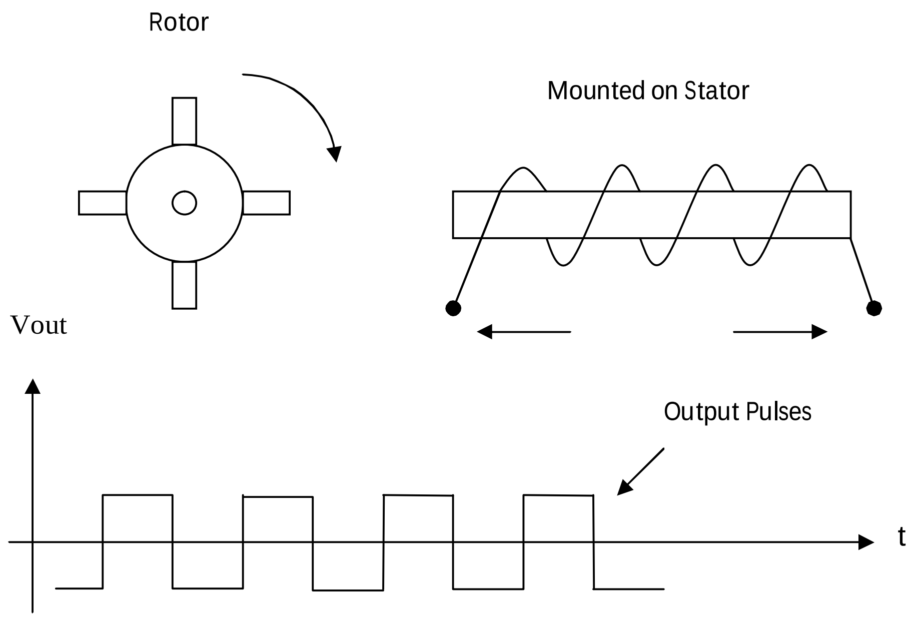

Figure 2.1: Toothed-rotor tachometer detection

The other type of tachometer that commonly used in industrial control application is rotary encoder. This instrument used a photo sensor and a disc which will be montage on the rotating shaft. The rotating disc has a narrow radial slit which allows light from LED go through the disc. Several photodiodes which are placed behind the slit will detected the light and produced modulated light beam in form of voltage pulses. This voltage signal will be amplified and generated into digital waveforms suitable for subsequent process.

The other type of tachometer that commonly used in industrial control application is optical rotary encoder. This instrument used a photo sensor and a disc which will be montage on the rotating shaft. The rotating disc has a narrow radial slit which allows light from LED go through the disc. Several photodiodes which are placed behind the slit will detected the light and produced modulated light beam in form of voltage pulses. This voltage signal will be amplified and generated into digital waveforms suitable for subsequent process.

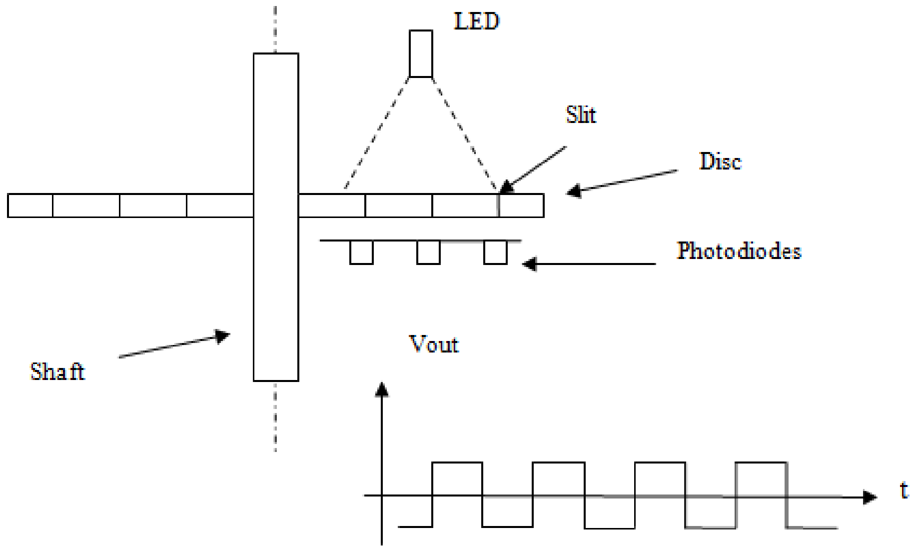

Figure 2.2: Optical Rotary Encoder

The disc of the optical rotary encoder has to be assembly perpendicular to the rotating shaft of the motor. It must be tight up to the shaft to be reducing disc shaking during rotating that can be effect the detection of light beam. Furthermore, the disc has a weight and that can be affect minor error to the result. At this point of view, the infrared tachometer sensor has advantage compared to the optical rotary encoder.

The infrared tachometer sensor needs only a reflector which have black and white stripe. The motor shaft will be covered with the reflector and the infrared sensor is