LASER RANGE METER

SYED AMIR REDHA BIN SYED MOHMAD

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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SYED AMIR REDHA BIN SYED MOHMAD

This report is submitted in partial fulfillment of the requirement for the award of Bachelor Electronic Engineering (Wireless Communication) with honours.

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Sesi Pengajian :

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Prepared **: MR FAUZI BIN ABDUL WAHAB.**

Date **: 3RD MAY 2011.**

To my beloved mother and father,
my family, Mr Fauzi bin Hj Abd Wahab and all my friends…

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ABSTRACT

This project is about laser length meter. Transmitter circuit emits laser pulses with a defined wavelength and frequency. The laser beam is reflected off the target and back to the receiver unit at the speed of light. The returning wavelengths and light pulses change in relationship to the ones sent out by the meter. The difference between the two signals is proportional to the distance and the target. A comparator circuit will compare the different wavelength and frequency between transmitter circuit and reflected signal at receiver circuit. Different distance will give different output voltage at comparator circuit. Microcontroller circuits will the process analog data from comparator circuit to digital data and manipulate the data to display at LCD for convenience reading distance.

ABSTRAK

Projek ini adalah tentang alat pengukuran jarak. Litar pemancar akan memancarkan sinar laser dengan panjang gelombang dan frekuensi yang ditetapkan. Pantulan akan diterima pada litar penerima pada kelajuan cahaya. Perubahan panjang gelombang daripada sinar pantulan akan berubah dengan perubahan jarak. Litar pembanding akan membandingkan panjang gelombang yang berbeza daripada litar pemancar dan litar penerima. Jarak yang berbeza akan memberikan nilai keluaran voltan yang berbeza pada litar pembanding. Litar pengawal mikro akan memproses data analog daripada litar pembeza kepada data digital dan memanipulasikan data untuk dipaparkan pada LCD untuk kemudahan membaca jarak.

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LIST OF SYMBOLS AND ABBREVIATIONS

A	-	ampere
c	-	coulomb
cm	-	centimeter
F	-	farad
f	-	frequency
Hz	-	hertz
I/O	-	input/output
k	-	kilo
kHz	-	kilohertz
kΩ	-	kilo-ohm
M	-	Mega
MHz	-	Megahertz
MΩ	-	Mega-ohm
m	-	meter
mA	-	milliampere
mm	-	millimeter
m/s	-	meters per seconds
cm	-	centimeter.

CHAPTER I

INTRODUCTION

1.1 Project background

Usually, human measure the distance using conventional methods (meter tape or ultrasonic range meter). It is limited to a distance and there are some weaknesses, particularly in the area that is difficult to achieve. To enhance the capability and suitability to measure, the project will be developed is intended to measure a distance between one point to another point with a laser beam. Laser is easily applied compared the conventional method.

This project will use the concept in which transmitter circuit emits laser pulses with a defined wavelength and frequency. The laser beam is reflected off the target and back to the receiver unit at the speed of light. The returning wavelengths and light pulses change in relationship to the ones sent out by the meter [5]. The difference between the two signals is proportional to the distance and the target. A comparator circuit will compare the different wavelength and frequency between transmitter circuit and reflected signal at receiver circuit. Different distance will give different output voltage at comparator circuit. Microcontroller circuits will the process analog data from comparator circuit to digital data and manipulate the data to display at LCD for convenience reading distance.

This project is mainly focused on a different approach of laser based on the capabilities of modern microcontrollers. The method implemented by this system is based on its capability of performing fast measurements of laser characteristics. The proposed microcontroller configuration is capable to measure the frequency and the amplitude of each period of the incoming signal, along with the time of arrival of each period. These measured values are then being used to provide the desired characteristic of the transmitter and receiver unit [4]. In this project, laser operating essentially operating at resonant frequency of 1250 Hertz (1.25 kHz) referring by calculation at transmitter circuit.

1.2 Problem Statement

The problems described below are concerned with the measurement of the distance between 10 meters to 100 meters.

1. Accuracy problems when using a tape meter and ultrasonic.
2. Problem the number of people used during the measurement process.
3. Measurement problems when measure the distance in a hard to reach.

1.3 The objective

The objective for the project is build laser range meter. In addition the project also incorporates ideas and technology which could produce a better product innovative which marketed locally or internationally.

1.4 Scope of work

Expected results for the laser range meter project is a device that can measure distance using laser beam with a higher accuracy better than using conventional tools such as tape meter, or ultrasonic range meter. Laser range meter also can help in making measurements in places difficult to achieve.

In addition, these devices are expected to help the technical group to make the measurement more accurate and precise when they carry out work related to their field. Besides that, expected results for the proposed project are:-

1. Construct a laser light transmitter circuit.
2. Construct a receiver circuit suitable for transmitter circuit.
3. Construct a comparator circuit where can compare two different wavelength.
4. Identify and build the interface circuit for LCD display.
5. Obtain the computer programming and coding.

1.5 Thesis Outline

This report represents five chapters. The following is the outline of the design/analysis of Laser range meter project in chapter by chapter.

Chapter 1: This chapter is discussing about the overview of the project such as introduction, objective, problem statement and scope of the project.

Chapter 2: This chapter describes about the research and information about the project. Every facts and information which found through journals or other references will be compared and the better methods have been chosen for the project.

Chapter 3: This chapter discuss about the project methodology used in this project such as data capture and comparison process. All these methodology should be followed for a better performance.

Chapter 4: This chapter describes about the project the findings such as result and analysis of the electronics component.

Chapter 5: Discussion, conclusion and suggestion for this project.

CHAPTER II

LITERATURE REVIEW

2.1 Laser

Lasers are focused, intense beams of light, usually of a single frequency. Laser very useful for measuring distances because laser travel at constant rates through the air and travel much longer distances. A laser pulse retains much of its original intensity when reflected off the target, which is very important when calculating distance to an object [1].

An electrical pulse generator will drives a semiconductor laser diode sending out infrared light pulses. At the receiver unit, the echo signal reflected by the target hits a photodiode which generates an electrical receiver signal, [1]. The time interval between the transmitted and received pulses will calculate. The calculated range value is fed into the microcomputer which processes the measured data and display at LCD display.

Laser range meters emit light pulses with a defined wavelength and frequency. The laser beam is reflected off the target and back to the distance meter at the speed of light. The returning wavelengths and light pulses change in relationship to the ones sent out by the meter. The difference between the two signals is proportional to the distance to the target.

2.2 An advantages of laser length meter

Unlike ultrasonic meters, the laser length meter's narrow laser beam prevents the reflection off objects that aren't targeted, avoiding false readings. Laser distance meters are much more accurate and reliable, and measure much longer distances than ultrasonic meters [3]. The advantages using laser length meter is:-

1. Fast measurements:

   Turn on switch at point to measurement, the measurement is done. Anyone can use easier.

2. Easy access:

   Just aim the laser at the point for measurement.

3. Reduce errors:

   Laser distance meters not accidentally read the wrong scale.

4. One man operation:

   Compare to conversional way to take measurement, laser distance meter only require one people to get result.

5. Highest accuracy:

   The accuracy for this laser length meter is ± 1.5 mm (± 0.059 in) [1].

6. Longer distances:

   Laser distance meter can measure up to 100 meters (330 feet).

2.3 Speed of light

The speed of light, usually denoted by c, is a physical constant important in many areas of physics. Its value is exactly 299,792,458 meters per second, it is the maximum speed at which all energy, matter, and information in the universe can travel. It is the speed of all mass less particles and associated fields – including electromagnetic radiation such as light – in vacuum, and it is predicted by the current theory to be the speed of gravity [2].

In most practical cases, light can be thought of as moving instantaneously the speed of light can be used with time of flight measurements to measure large distances to high precision [3]. Table 2.1 show the distance versus time for speed of light in air.