LASER GUN SYSTEM: MEASUREMENT AND COMPARISON

ABDULLAH BIN ALI

Tesis Dikemukan Kepada

Fakulti Kejuruteraan, Universiti Malaysia Sarawak

Sebagai Memenuhi Sebahagian Daripada Syarat

Penganugerahan Sarjana Muda Kejuruteraan

Dengan Kepujian (Kejuruteraan Elektronik dan Telekomunikasi)

2002

Borang Penyerahan Tesis
Universiti Malaysia Sarawak

BORANG PENYERAHAN TESIS

R13a

Judul : LASER GUN SYSTEM: MEASUREMENT AND COMPARISON

SESI PENGAJIAN: 1999/2002

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APPROVAL SHEET

This project report attached here to, entitled "Laser Gun System: Measurement and Comparison" prepared and submitted by Abdullah bin Ali as a partial fulfillment of the requirement for the degree of Bachelor in Engineering with Honour in Electronic and Telecommunication in hereby read and approved by:

________________________	26.03.2002
(Mr. Kismet Ak. Hong Ping)	Date
Supervisor	

To my loving parents; Ali Abang and Hajijah Saibon,

My Brothers; Alfian and Arjeffri, my sister; Soffia,

And to my little brothers; Affiz and Afi

I LOVE U ALL

ACKNOWLEDGEMENT

First and foremost, sincere gratefulness to the Almighty Allah S.W.T for giving the strength toward the completion of this project. Special thank to the author's supervisor, Mr. Kismet ak. Hong Ping, for supervise, reviewed and provided valuable suggestion and advise on parts of the thesis.

Also, I would like to thank to my lectures, Mr. Thelaha and Mr. Ng Liang Yew for suggestion and ideas. To technicians, Mr. Haji Wan and Mr. Zakaria, thank for your help and cooperation.

My gratitude also goes to friends, Dayang Azra, Evelyn, Tina, Sylvia and Nurhasifah for your sharing experience and friendship with me. Not forgotten to Noni, Suraya, Kamarulzaman and Ting Tiew On, thank for your helping in Visual Basic programming.

Last but not least, I want to thank the most important in my entire life, my parents, Ali Abang and Hajijah Saibon, my brothers, Alfian and Arjeffri, my sister, Soffia and my little brother, Affiz and Afi. My studies and this thesis would not have been possible without their love, support and understanding my attitude. Thanks a lot.

ABSTRAK

Sistem *Laser Gun* adalah suatu sistem yang digunakan untuk mengukur kelajuan dan kedudukan sesebuah kenderaan. Dengan menghantar cahaya laser jenis *infrared* ke sasaran dan kembali semula ke penerima *Laser Gun*, tempoh masa ulang-alik cahaya laser dapat ditentukan. Namun, bacaan kelajuan yang diperolehi oleh alatan *Laser Gun* ini sebenarnya tidak memberi bacaan kelajuan yang sebenar memandangkan masih terdapat faktor-faktor semulajadi yang mempengaruhi bacaan kelajuan tersebut. Faktor-faktor semulajadi ini sememangnya tidak dapat dielakkan mahupun dikurangkan, tetapi ia dapat dipertimbangkan dalam memperolehi kelajuan sebenar sesebuah kenderaan. Jadi matlamat utama tesis ini adalah untuk mereka bentuk sebuah sistem pengiraan kelajuan sebenar sesebuah kenderaan dengan mempertimbangkan faktor-faktor yang ada. Kajian tesis ini juga membuat perbandingan di antara model *Laser Gun* dengan meneliti pelbagai aspek melalui spesifikasi pistol laser itu sendiri. Perbandingan ini dilakukan untuk mendapat *Laser Gun* yang paling baik dari segi pengesanan kelajuan, jarak, masa perolehan, pencapahan cahaya dan model yang paling ringan. Sebagai tambahan, reka bentuk sistem yang dicipta juga berupaya untuk menyimpan infomasi kenderaan yang diperolehi hasil daripada "speed trap" yang dijalankan dan menukar nilai kelajuan dalam unit yang berbeza.

ABSTRACT

Laser Gun system is the system that used for measure the speed and distance range of moving vehicle. The transit of time can be calculated when the Laser Gun is sending the infrared light to the target and reflect back to the Laser Gun receiver. But, the speed-reading of vehicle which showing in the Laser Gun display is not the actual speed of vehicle because there has a potential error or natural factor that influence the speed reading. This error cannot be avoiding or decreasing, but it can be considering in the actual speed of moving vehicle. So, the main objective in this thesis is to design the measurement system of actual speed of vehicle with considering all the potential error. This thesis also doing the comparison between Laser Gun models with considering a few aspect from the specifications each Laser Gun model. The main objective of this comparison is to analyze and get which of this model provide the best performance in speed detection, distance range, acquisition time, beam divergence and the lighter of weight. In addition, the function of measurement system design is can store the vehicle speed information from the police traffic speed trap and can convert the difference speed unit.

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CHAPTER 1

INTRODUCTION

1.1 Lasers and Laser Gun History

A German physicist, Albert Einstein was working on some concepts concerning light. In 1916-1917, he showed that molecules that were energized gave off s monochromatic light or a light occupying only a small portion of the light spectrum, often thought of as one-color light [1].

Research on "Maser" was motivated by the idea that utilizing a transition between the energy levels of atom or a molecule produces a stable frequency source. The "Maser" stands for Microwave Amplification by Stimulated Emission of Radiation. In 1951, Townes and Schawlow, and Basov and Prokhorov, independently conceived of Masers on the basis of such principle. The Maser was soon followed by lasers, which now rank as the highest-performance devices for frequency standards [2].

Gordon Gould and executives from TRG Inc., a small Long Island company, got an enthusiastic reception when they presented the Pentagon with a proposal to build a laser. In mid 1960, Gould proudly demonstrated the world's first laser [17]. A second type of solid-state laser was reported, trivalent uranium ions in calcium fluoride, by Peter P. Sorokin and J. Stevenson in 1960. This was followed in May 1960 when Theodore Maiman built the working laser model, using a ruby cylinder [1].

In 1961, the demonstration of the helium-neon laser by Ali Javan, W.R Bennett Hill where their first helium-neon laser operated at 1.15 micrometers in the near infrared. L.F. Johnson and K. Nassau demonstrated the first neodymium-glass laser at American optical in the same year. After that, in 1962 the other researchers found the 632.8 nanometer red lines by White and Ridgen, which has made helium-neon laser one of the most widespread types [3].

J.E. Geusic, H.M. Marcos, and L.G. Van Uitert were demonstrated yttrium aluminum garnet (YAG) as a laser material in 1964. Three separate groups demonstrated the first semiconductor diode lasers nearly simultaneously in fall 1962. All three teams at General Electric Research Laboratories in Schenectady (New York), the IBM Watson Research Center in Yorktown Heights (New York) and MIT's Lincoln Laboratories in Lexington was demonstrated similar gallium arsenide diodes cooled to the 77K temperature of liquid nitrogen and pulsed with high-current pulses lasting a few microseconds [3].

In 1964, William B. Bridges observed 10 laser transitions in the blue parts of the spectrum from singly ionized argon where the basis of today's argon ion lasers. At the same year, C. Kumar N. Patel obtained a 10.6-micrometer laser emission from carbon dioxide. But in 1966, Sorokin and J.R Lankard demonstrated the first organic dye laser, today a standard tool of laser spectroscopy [3].

The first chemical laser is J.V.V. Kaspar and G.C Pimentel demonstrated the hydrogen chloride emitting at 3.7 micrometer in 1965. In the mid 1970s, interest shifted to rare gas halides, which are much more practical light sources and which have become a significant part of the laser business. In 1977, Gordon Gould was patent covers optical techniques for pumping or energizing the laser medium, such as using a flash lamp to drive a dye or neodymium laser [3].

In 1979, Gould also patent covers a range of laser application. The major research breakthroughs of the 1980s were dramatic extensions of the wavelength and power range of semiconductor lasers, development of new families of tunable solid-state laser, and demonstration of x-ray lasers. Then, in 1987, Gordon Gould patent covers pumped by electric discharges and the 1988 patent covers the Brewster angle windows used in many lasers. Table 1.1 shows the history of laser in summary for some year [2]

YEAR	NAME	DESCRIPTION
1958	Schlow, Townes	Proposal of optical Maser K light pump, unsuccessful
	Basov	Theory of Optical Maser
1959	Schalow	Proposal of ruby laser
1960	Maiman	Ruby laser oscillation successful
	Sorokin	Uranium laser
1958-1960	Aigrain (France)	Proposal of semiconductor laser
	Nishizawa (Japan)	
	Basov (USSR	
1960	Javan et al	He-Ne laser (internal reflecting mirror)
1961	Rigrod	He-Ne laser (external reflecting mirror)
1962	White	He-Ne laser ($\lambda = 0.6328\ \mu m$)

	Nathan el al (IBM)	Semiconductor laser
	Hall et al (GE)	
	Quist et al (MIT)	
	Holonyak et all (III. Univ)	
1963	Mathias	N_2 laser
1964	Geusic	YAG laser
	Bridges	Ar-ion laser
	Patel	CO_2
1965	Kholov	KDP optical parametric oscillator
	Wang	ADP optical parametric oscillator
	Giordmaine	$LiNbO_3$ Optical parametric oscillator
1966	Sorokin	Dye Laser
1969	Hayashi, Panish	GaAs/GaAlAs, double heterostructure semiconductor laser
1970		Double heterostructure room temperature CW
1973		Coherent ultraviolet ray
1975		Elongation of life of semiconductor laser
1976	Hsieh	GaInAsP Semiconductor laser ($\lambda \approx 1.1$ μm)
1978	Several groups	GaInAsP semiconductor ($\lambda \approx 1.3$ μm)

Table 1.1 Summary of laser history

For Laser Gun history, it is more related with 'speed trap" method cause the laser Gun function is to measure the speed of vehicle. In 1909, police traffic does not have some equipment to get the speed of vehicle when they do some speed trap in the road. So, police traffic used the manual method that called as "the mark 1 stop watch". This method is very simple stopwatch to time the passage of a car between two known and fixed positions [4].

A "speed trap" was set up by two policemen who began by carefully measuring a section of road and setting up two observation positions where one officer was placed at each of the trap. As a car passed the first officer he made a signal (example: raised his hand) and the second started his stopwatch. When the car passer the second fixed point, the other officer pressed the button to stop the watch and had a measurement of the time taken to travel a known distance.

Finally, the speed of the car could be calculated (or found by referring to a book of tables). As cars traveled relatively slowly, the officer had time to step out and stop the car. Figure 1.1 shows the first police traffic made a signal in "the mark 1 stopwatch" method.

Figure 1.1 "The Mark 1 stopwatch" manual methods

In 1905, another method to detect the speed vehicle was become in particular along the London to Brighton road where motorists began to view speed traps as a serious nuisance to their motoring pleasure. In the same year, the Automobile Association (AA) was being form. The new AA was soon campaigning for fair deal for its members and recruited its first AA patrolmen to patrol the road, keeping a wary eye open for hidden police speed traps [4].

Members were issued with a badge to fix on the front of their car and patrolmen were instructed to look at the front of approaching cars and salute those that showed the badge of membership. If the patrolman did not salute, then members were advised to stop and ask the reason why. It was illegal for the patrolmen to warn approaching motorist of a police trap (the patrolman could be arrested and charged with obstructing a police officer in the course of his duty) but if the motorist stopped to ask a patrolman and was advised of road conditions.