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EVALUATION OF EXISTING DISTANCE MEASURING/ RANGING TECHNIQUES AND ESTIMATION OF A STATURE FASTEN SYSTEM USING LASER RANGING PERFORMANCE

Abdur Rehman[*1], Muhammad Haneef[2], Sajjad Karim[3] & Muhammad Ali[4]
[*1,2,3&4]Electrical Engineering Department Foundation University Islamabad (Rawalpindi Campus) – Newlalazar Rawalpindi-Pakistan

ABSTRACT
Ranging/distance measurement is one of the important parameters which can reflect any of the ranging system's performance. Evaluation of existing distance measuring techniques has become an imperative study. In this paper an attempt is made to analyze some of the established ranging techniques, particularly, the range measuring capacity of laser ranging system. Ultimately a, novel process which can estimate that stature fasten system of laser ranging technique is anticipated. Experimental result shows that technique of pulse laser range finder can be measured accurately. A FMCW based laser technology for distance /range measuring fairly close substance is intended. This archetype arrangement will be a single impartial tool premeditated for both technological and non technological applications.

KEYWORDS: Control systems, Distance measurement, Measurement techniques, Microcontrollers, Proto-types, laser ranging, Ranging System**.**

INTRODUCTION
Currently, with the advancement of modern industry, mechanical ranging technique has been extensively adopted in numerous scenarios such as navigation, robots, parking radars, machining and other applications. There are many ranging methods have been in practice. The commonly used procedures include the microwave ranging, ultrasonic ranging, laser ranging, infrared ranging, eddy ranging, spread spectrum ranging techniques etc. These procedures are incorporated at various scenarios in accordance with applicable operational distinctiveness. Both the literature and the technical credentials purpose various range measurement principles /techniques, showing wide performance range but implying high cost when safely requirements and clear surface /range sensing have to be assured. Ranging is the phenomenon which is incorporated for the institution/establishment of the space of an object with respect to the allusion/ground location. As long as microwave technology is concerned, the impediment during the packet of a translated (modulated) signal/energy plays a vital role in resolving the space/height. In this system, only small transmission bandwidths are incorporated with the potential of disregard to upsetting features/parameters, such as obstacles, wind/storm effect etc. In an analysis, the realistic incident with the EXOCET etc in current past has exposed that certain accessible surveillance devices are in need of the supreme survivability beside the menace situation. The ranging procedure accomplished in laser technique with the help of the distance covered by the instance of taking a round trip of an optical ray transmitted by a light supply and then back with restraint is utmost range to pragmatic targets. For a long, it has been observed with great concern that certain in-flight assignments/missions are a head of the individual survival. A procedure basing on the least space and negligible area is anticipated to be the mainly proficient/imperative elucidation for this important issue. The existing surveillance device possesses the altitude/range measurement of approximately a few hundred meters above the ground level. The need has felt to undertake an altitude/range measurement, which should reduce this altitude to bare minimum with great reliability and accuracy, so that the autopilot capability of these devices may be enhanced manifolds.

ULTRASONIC MEASUREMENTS
The ultrasonic measurements are accomplished as per the analogy of Trip Time calculation. Pulse-echo measurement applications are carried out with the transmission of a short train of waves and reception of a reflected signal from the transducer (same transducer is used for both the functions i.e. transmission and reception) The amplitude of the received waveform is an envelope which starts from zero level reaches to a peak and then dies out.

The echoes are mostly detected by simple threshold crossing technique, which is also cause of error. The digital signal processing is used to calculate the time delay in reception i.e. T.o.F, for which a maximum similarity between the reference and the delayed echo signals is obtained. To observe the effect of phase uncertainties and frequency shifts (Doppler), this processing is carried out, both directly on the actual wave shape (and after extracting the envelopes of the reference) and delayed echo signals. Several digital signal processing algorithms are considered and the effects of different factors such as sampling rate, resolution of digitization and S/N ratio are analyzed. Result show accuracy, computing time and cost for different techniques. There are several procedures of ultrasonic ranging, a few are phase detection procedure, amplitude detection technique and round trip time detection phenomenon. The high precision/accuracy is estimated in the phase detection method however, the scope of testing is inadequate: acoustic amplitude detection is vulnerable for the reflected wave. In the working principle of ultrasonic, the signal is transmitted at a given time from the initiator/generator, on meeting the measured object, it will be reflected back to the ultrasonic receiver and received by this transducer. As long as echo time is computed, the propagation speed in a medium is known. The formula for distance measurement in the scenario of pulse counter for accuracy is given by:

$$d = s/2 = \acute{v}xt/2 = Nc/2f \qquad (1)$$

Where d is the distance from device to the object, v is the spread in the medium, t designates time from ultrasonic transmitting to receiving, N is the Pulse number and c denotes the speed of light.
This basic principle is shown in fig-1

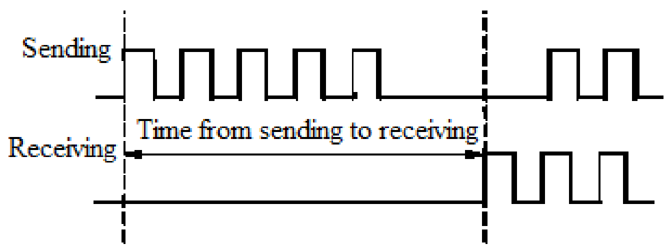

Fig 1: Basic principle of ultrasonic ranging

SPREAD SPECTRUM RANGING SYSTEMS

Spread Spectrum Ranging Systems are the one which make use of a much wider bandwidth signal rather than the least requisite bandwidth. The spreading is accomplished by a modulation technique whereby the given signal is modulated with a random fashioned code of a very high bit rate. The correlation of the received signal with an internal reference code (synchronized with the original code) will result into the dispreading of the code. A signal considered to be not a replica of the reference code will be spread with the help of the reference code. The two viable modulation methods employed include Direct Sequence Ranging System [the modulation between a digital code sequence and a carrier takes place] and Frequency hopping system [Here as per the code sequence the transmitted signal frequency shifts from the frequency to frequency]. The applications of spread spectrum ranging system are not very common for practical use; however the Position Location Systems, Space/Avionics Systems are some of the imperative areas of Spread Spectrum applications.

GLOBAL POSITIONING SYSTEM [GPS]

The GPS operation scenario revolves around satellite technique of distance measurement while establishing/forming the user location on the earth and calculating their space from the set of satellite. A precise position and time signal is transmitted by a each GPS. The time delay determined by the user’s receiver will attribute towards undeviating appraise of the perceptible range/distance to the satellite. In an estimate, the GPS navigation technique takes one second for processing the update rate of information. To get the real information from autopilot vehicles, the system may breakdown in one second processing duration. GPS works in all the circumstances round the clock. GPS sends out signal data to ground where user's accurate position is undertaken by the GPS receivers. On comparing time at which information was sent out by a satellite and by means of the time it was received, such time difference shows the GPS receiver at what distance the satellite takes place. Following such applications with a little further satellite, the recipient device can be in position to establish user's location and be able to exhibit it on the outfit digital record. To get better accuracy/ resolution/ precision, another technique, known as Differential GPS (DGPS) may be adopted for

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corrected GPS outcome to an average of approximately four to six meters. The working phenomenon is evident from fig 2.

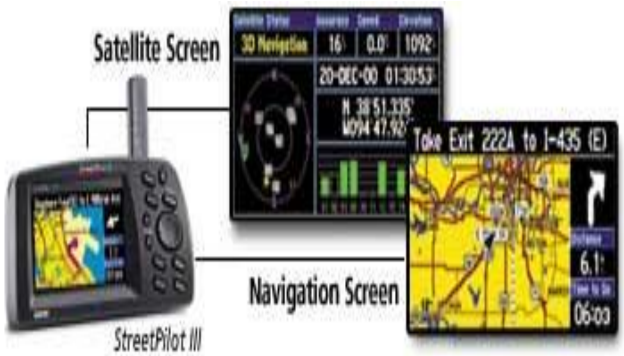

Fig 2: GPS Navigation system working

MICROWAVE RANGING

Microwaves are defined as the radio waves having wavelengths from one millimeter to one meter , or evenly with frequencies between 0.3 GHz and 300 GHz. Microwave subcategories include:(1) EHF being the uppermost radio (microwave) frequency band, it runs the frequency range from 30GHz to 300GHz, exceeding which e.m. radiation is measured like terahertz radiation. This frequency range corresponds to a wavelength range of 10 to 1 millimeter, so it is sometimes called the millimeter band. This band is commonly used in radio astronomy and remote sensing. (2) SHF is the description for radio frequencies for the band of 3GHz to 30GHz, which is also called as the centimeter band, for the reason that their wavelengths ranges from ten to one centimeter. (3) UHF designates the radio frequency band of 0.3GHz to 3GHz.Its applications include TV dissemination, mobile phones, satellite etc. In microwave procedure the distance is calculated with help of the impediment in the packet of a modulated signal of minimum communication bandwidths.

LASER RANGING

Lasers can be applied in a variety of ways to measure distances / displacements with no bodily contact. Actually they allocate for the most receptive and accurate duration/range determination. In case of exceptionally rapid demonstration in many megahertz bandwidths, these characters are generally not united by a solo practice. Owing to the explicit requirements, very diverse procedural methodologies can be appropriated.

The laser ranging system involving pulse approach is a one of the space-measuring mechanism that operates by emanating a small powered pulse towards the objective. A photo-detector device in the distance measurement scheme collects reflected pulse wave. In computation of the time space it is mandatory for the energy to pass through from the source to object and advent; turn around distance can be resulted. A few fundamental techniques used for laser ranging are: (a) **Triangulation** is taken as a geometric/algebraic technique, considered practical for measurement in the band of 1millimeter to a number of kilometers.(b)**Time of flight**s*(*pulse computations*)* is focused on calculating the laser beam flight time from the referenced device to an object and return. These schemes are classically functional in support of large measurements even upto several kilometers with the accuracies of few millimeters or centimeters for short distance. (3) **Phase shift technique** incorporates an intensity-modulated laser beam. In contrast to the interferometery techniques, its precision is lesser; however it permits definite calculation over greater distances appropriated for objects with scatter ed indication/clue. FM techniques involve frequency-modulated laser waves and the space to be determined can be modulated into a frequency counteract, calculated through a beat frequency related to the transmitted and received beam. An accuracy/precision in an extremely improved version in space calculation as compared to the wavelength of light can be achieved with help of Interferometer. Fig 3 shows the block design of type of laser ranging system, where the distance is measured between the source and object (target).

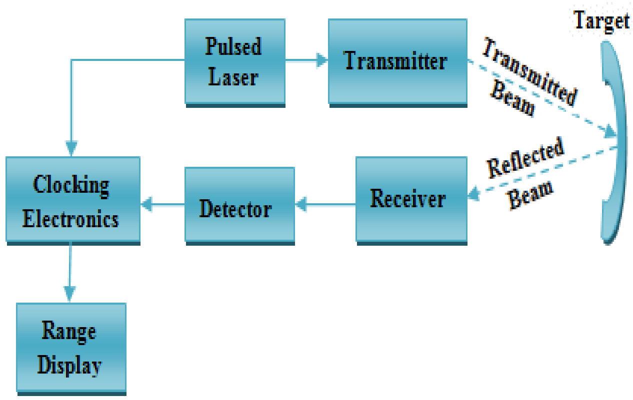

Fig 3: Block design of ranging arrangement

The illustration of this figure incorporates the measurement of the time interval [i.e. from the time the signal is transmitted and then returned to detector] in order to compute the distance. The function of transmitter is just like an aerial mission for lessening of deviation (divergence) angle of the source beam intended on the object. Receiving structure basically collects a portion of the returned laser beam and directs it onto the detection device. To establish relationship between the required parameters in terms of transmitted power, detector sensitivity, antenna size, and geometrical factors received power, it is referred to what is known as in radar terminology, the "range equation." Here it is assumed that the entire area of the target is covered by the transmitted power which is used to redirects the beam to the transmitter. The radiation pattern relating to transmitter-to-target geometry is illustrated in fig 4.

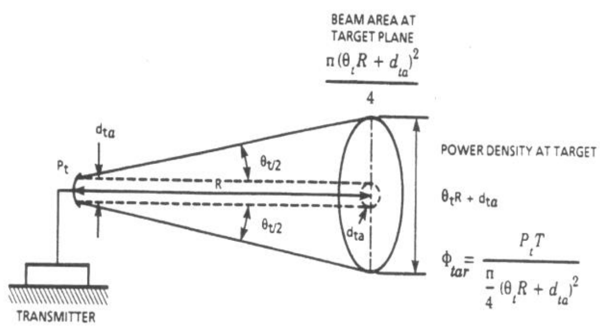

Fig-4 Geometrical approach of Transmitter towards Target

During such arrangement, a transmitted ray is exhibited where the transmitter antenna possesses the aperture diameter of d_{ta}, with the deviation angle $ø_t$ (rad). On the target plane, a distance R from the source, the illuminated area from the transmitter/source, A_R is given as:

$$A_R = \frac{4 P_t T}{\pi(\theta_t R + d_{ta})^2} \quad (2)$$

The calculation of the uniform power density Φ_{tar} within this area is given by the equation-3, stressing on the ratio of transmitter/source power to the illuminated region/area, and with implication to ambiance Transmission *T*: This relationship is also incorporated to determine the power density at object in non-cooperative as well as supportive objects.

$$\phi_{tar} = \frac{4 P_t T}{\pi(\theta_t R + d_{ta})^2} \quad (3)$$

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A. Laser Pulse Time-of- Flight Distance Measurement

This measurement technique refers to the time the laser pulse system takes for a pulse as it travels from its source to and from an object (under observation) (t_d). In case of light as an energy source, then velocity of light will be taken as a relevant parameter involved in range estimation. This system undertakes the round trip time from a light pulse transmission to its echo and the deliberated time taken is the outcome of the twice distance traveling which should be minimized by half ,so that the actual distance can be measurement to the object.

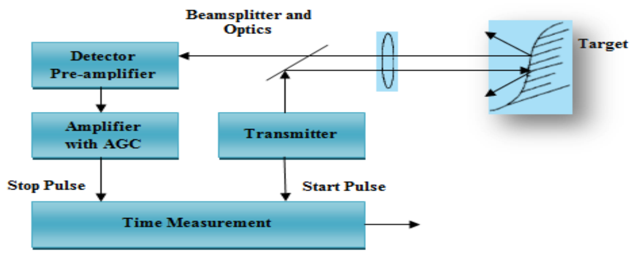

Fig 5: Block illustration of TOF laser ranging

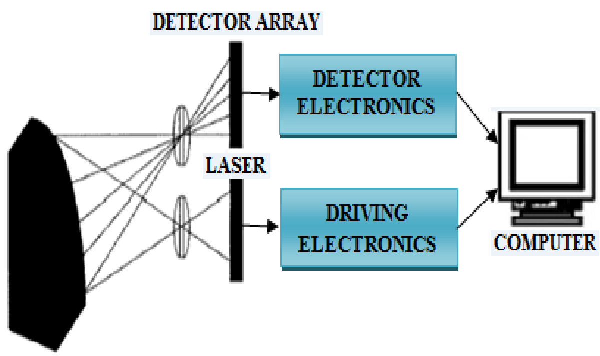

Fig 6: Diagrammatic illustration of focal plane scanning

As, a solo pulse is considered to be sufficient enough for the unambiguous finding of range with centimeter correctness in distance perspective, therefore such technique will be given due weight age. Fig-5 exhibits the obstruct illustration of TOF laser range finder. In a fabrication perspective, this system includes a laser source transmitter; receiver channel including photodiode, amplifier and Automatic gain control **(**AGC) coupled with the constant fraction discriminator (CFD) or timing discriminator. The transmitted light signal (start pulse) triggers the time interval/delay measurement entity and the return signal (stop pulse) stops it. Such distance/space to the object (target) is proportional/relative to the time interval/delay. In 3–D measurement, the LRF is equipped with angle encoder for coordinating the measurement points. Focal plan scanning for scanning a surface mechanically point by point can be used with high performance. The rule /principle for scanning focal plane are also exhibited in fig-6.

B. Frequency Modulated Continuous Wave (FMCW) (Optical) laser ranging technique

In this perspective, imaging principle is followed by FMCW radars; that is, they achieve small segments/resolution cells of the background, calculate/observe changes in the pulse return from each cell to spot small targets, like walking human beings. Unique resolutions for these radars are approximately less than 1 meter as well as less than 1 degree in range/distance and in azimuth respectively. In FMCW operation, the target direction or speed will not be effected; the only parameter which is affected is its volume with reference to the resolution cell in which it is positioned. In FMCW like technique, the Frequency modulation occurs between laser power and a ramp / sinusoidal wave and resultantly the returned signal is received with a time impediment in relation to the transmitted one. While mixing these two signals, a beat frequency (intermediate frequency) will be resulted by the relationship [(f_b=$f_e(t)$-$f_r(t)$]. The distance can be approximated by the relationship [d=F_bCTr/4Δf] where F_b is the beat frequency, Tr is period of ramp, c is speed of light and Δf stands for modulation frequency bandwidth. The performance of this procedure is appreciable rather twice as large as compared to the pulse radar system. The range difference R, is taken as distance between an object and a reference object (mirror), is proportional to the f_{if} =F_b as indicated in fig 7.

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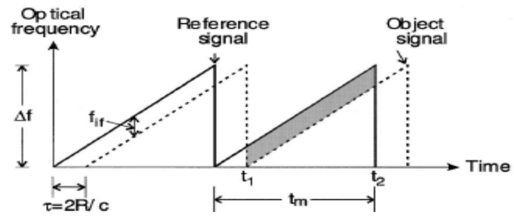

Fig-7: Illustration of direct optical frequencies versus time of the object / reference echo optical signals in linear optical frequency access ramp situation

Where τ =2R/c [τ denotes the time delay of the object signal from object to the target and back], and the intermediate frequency amounts to $f_{if} = f_b = \Delta f \,, \tau/t_m = 2\Delta f\ R/ct_m$,where t_m denotes ramp period(.1→1ms). FMCW can determine τ values in picoseconds range, while R is measured in millimeter range.

C. Phase –Shift Laser Range Finder

Laser range finders follow the *phase shift methodology*, where the distance measurement takes place in following fashion. A laser beam is transmitted towards the target and accordingly some reflected light is noticed from disperse reflections. The comparison of phase relationship takes place between the power modulation and sent light, which is 2π times. This reveals that higher spatial resolution can be obtained from higher modulation frequencies. As phase shift is considered to be directly consequence to the TOF, the term TOF *method* may be earmarked to the case where one actually measures a delay time more unswervingly. In case of an interferometer, the phase shift method involves an uncertainty concerning the computed space, for the reason that with escalating distance, the phase will differ sporadically; however, the periodicity factor is greatly enhanced in comparison to an interferometer, as the modulation frequency is much smaller than the optical frequency. Also, the vagueness may be uninvolved. In contrast to the interferometers, the devices with phase shift technique are fewer precise, but they allow explicit dimensions over bigger distances. Moreover, these are considered appropriate for objects with diffused/dispersed expression from an irregular/uneven plane.

SYSTEM REQUIREMENT AND ADAPTABILITY

The functional/field act (such as the velocity, accuracy and adaptableness etc) of these ranging/distance measurement outfits is to a great extent reliant on its environmental/field responsiveness. These roles which can be undertaken by various procedures have to be adhered. During performance/course of action, the data acquisition/processing times should be bare minimum and scheme must function in severe/stern circumstances. Laser ranging technique at the stance of having more adoptability/viability is being deliberated, and is taken as a choice to undertake this study as compared to the supplementary existed techniques.

Design Philosophy

As in altitude measuring devices, the function revolves around small power radar arrangement that transmits its power in a descending fashion through a very wide ray. On returning of strong echo from the earth's surface, this round trip travel time exhibit the elevation/distance of the object in relation to the ground. This measured altitude/elevation shows the frequency difference of emanated waves to the returned waves; while the calculated beat frequency is exercised for computation of distance. During this course of study, when an object and radar are taken at rest then no echo will be found. In these circumstances, a creation of thought for a shift in frequency electronically has to be visualized, which can only be consummated with the creation of an access to ramp generator. There are mainly two types of altitude measuring devices, currently in use are: 1) Aneroid barometer 2) Radio Altimeter. The aneroid barometer is incorporated for measuring the height of a target above the mean sea level, whereas the Radio Altimeter is fabricated to measure the absolute value of the elevation/distance on the analogy of the transmit /receive signal. Here the thought is adopted to underway Radio Altimeter

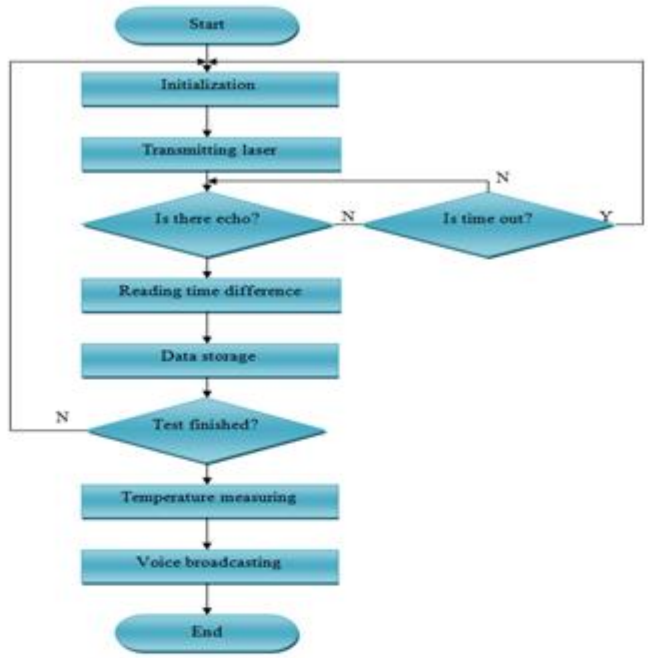

Fig 8: Program Flow Chart

Software Design

The software analogy is furnished in the segment form, resulting in the completion of transceiver control and links/channels. Software design contains subroutines such as wave transmitting/pulse launching algorithm, reception of echo program, data acquisition/ processing, display/exhibition program and time delay calculation program. The program flow chart is shown in fig-8. The role of each section includes, laser transmitting, echo receiving, temperature measuring, displaying and Main program (finish initialization, to achieve the control in all subroutine modules and realize hardware coordination.

On operation of the control system, firstly it is initialized in a series of preliminary values for the system maturity which includes various waves transmission interval, range calculation aspects etc. After having the control of the port of emission of the square wave signals and a time delay, the receiving phenomenon starts as per the echo procedures for echo segment. If the system is timed out, then it is prompted to re-launch/re-initiate algorithmically: or else it may stop timing, resorts the difference to generate interrupt and ultimately the counting is stopped and repeats the dimension according to the scenery. On the same way, the analysis takes place whereby the acquisition/processing of the data, the distance value display and conduction of voice broadcasting occur as per practice.

Measurement Algorithm

In assay, the design under consideration contains 1) transceiver module 2) associated analog electronic circuitry section and 3) the programmable digital data acquisition/processing module. During analysis and setting up, this manuscript has been pondered on the realistic execution of an autonomous/self directed hardware situation around the transceiver and the programmable digital data acquisition system, micro-controller (or alike) integrated circuit emphasizing on the technique. The rationale of emergent of such algorithm is to accomplish a splendid measurement pledge. A few of basic link budget parameters, given due emphasis is:

a. ***Free Space Loss (FSL)***

Before determining the viability of the link, firstly free space loss (FSL) should be estimated because of the presence of reference (earth) and the blot of the ambiance. But it will set a viable/practical allusion for the real time usage. If the operation of transmitter and receiver is carried out at the same frequency at a given linkage, the computed loss may be no less than 120dB. In assay of such environments, subsequent computations/calculation may be considered.

- ***Functioning in approximately 10 GHz***

  FSL =Free Space Loss for operating at 0.200 Km one side FSL=32.44+20logF (MHz) + 20logD (Km)
  [Where D is the distance between the end link points]

  $FSL=32.44+20\log 10x10^3+20\log .4=104.99$ dB
  - Free Space Loss for operating at 0.100Km one way =98.47 dB
  - Free Space Loss for operating at a distance of 0.025km one way

  $FSL=32.44+20 \log 10x\ 10^3 +20\log .050 =86.42$ dB

- ***Working in approximately 23 GHz***
  - Free Space Loss for a range of 0. 200 km one way
    FSL=32.44+20logF(MHz)+20logD(Km) $FSL=32.44+20 \log 23x\ 10^3 +20\log .4=111.72$ dB
  - Free Space Loss for a distance of 0.100km one way
    FSL=32.44+20 logF(MHz) +20log D(Km)
    $FSL=32.44+20 \log 23x\ 10^3 +20\log .2 =105.7$ dB
  - Free Space Loss for a distance of 25 m one way
    FSL=32.44+20logF(MHz)+20logD(Km) $FSL=32.44+20 \log 23x\ 10^3 +20\log .050=93.65$ dB

The FSL computation analysis dictates that the distance measurement/ranging may be conducted at approximately in 10 GHz scenario.

b. *Echo Time Computation*

- Delay time for distance of 200 m ,
  t =2d/c = $2*200 /3x\ 10^8$ s =**1333. 4 ns** (c is velocity of light)
- Delay time for a distance of 100 m
  t =2d/c = $200/3x\ 10^8 = 66.6667/10^8$s=**666.666ns**
- Measuring above a distance of 25m
  t= 2d/c t =$50/3x10^8$ = **l66.666 ns**
- Delay time a distance of 5 m
  t= 2d/c , t= 33.333ns

The foregoing echo time computation reveals that the ranging / distance measurement in echo time scenario is 33.333ns to 1333.4ns. Such measurement may be rounded to 40ns-1400ns For even utmost implementation of the algorithm, such range may be estimated as 50ns -2000ns.

Implementation Approach

After having analyzed the measurement algorithms and allied calculations in the perspective of laser ranging, the voltage typically ranges from 5V-15Vin minimum to maximum aspects, which is evident from plotting that for 500MHz frequency set up the corresponding echo time calculated is 50ns. Hence followings are the outcomes:-

- F_{max} = 300 Hz (for waveform generation)
- V_{max} (in terms of frequency) = 800MHz
- A free running generator of 2 KHz will generate 6-10 KHz.
- If slope(ramp)is at π/2 rad, then m=slope=dy/dx =tanπ/2 =1
- Slope(Ramp) formula, Y= mx +Constant =x (if Constant=0)

Fig 10 approximately display the access ramp role of the time to the consequent frequency, at m =1

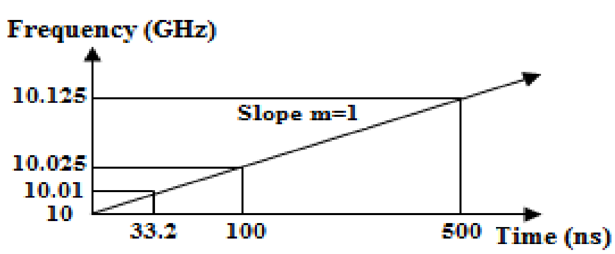

Fig 10: Time Vs Frequency Calculation

For production of electronically generated shift, it requires a shift of approximately 50MHz, which is a step towards the computation of beat (intermediate) frequency. Such effect is evident from fig-11.

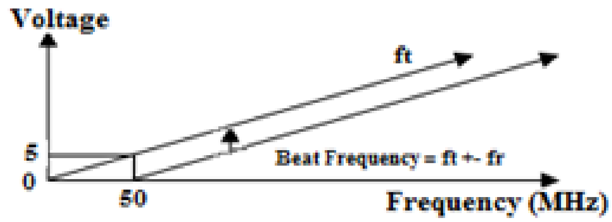

Fig 11: Beat Frequency Representation

Fig-12 is an indication of plotting test of altimetry calculation for the parameter of altitude vs. Time

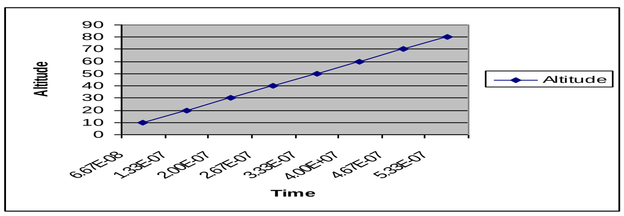

Fig 12: Altimetry Calculations

System Execution

In the execution perspective, such arrangement will focus on a 8 to 12 GHz sweep frequency sources in a general purpose perspective with the provision of the frequency locked. A 5V-15 volts generation will take place by ramp generator. The laser modulator will function for emission/transmission of laser wave and accordingly the APD detector and mixer will receive the signal after the reflection. This reflected signal is tied up to the F/V converter for the further processing /readability of the digital algorithm module. The function of ADC to reform such data (into 8-bit form) in sequence/progression is subject to the implementation of a high rating micro-controller. After necessary action by the range algorithm device/microcontroller, it is detected by peripheral interface which are programmable in nature. Provision of the requisite signal/data by the arrangement and the processing of vibrant band of the laser waves largely related to the detail application. An attribute of such devise/application is its strong confrontation to jamming and LPI.The structure has been categorized into two main functions: 1) Generation and transmission/reception (T/R) and 2) Sequencing, & Interfacing. The first function is accomplished by the ramp/slope wave generator, Laser modulator and APD detector T/R. The calculated 10ns—1000ns explode of the ramp wave is generated by Ramp generator. The echoes are improved, which is further noticed by the verge/threshold system. A filter is incorporated in the scheme to remove forged energy response. The second function(sequencing) is micro-controller / range finder algorithm based ,controlling the complete electronic circuitry which includes the production of the source instructions to T/R orders, the multiplexing/selection of the detected data provided by the same section, the code assignment of the calculated range via 8 bit and lastly the organization/management of the components involved).The Interface function permits the shifting of the computed measurements/dimensions to microcomputer (an IBM/PC-compatible)while making use of serial communication link as RS-232C (latest revision of the standard).

Figure-13 displays a sequence of the electronic cycle for the execution of laser measurement technique to assess /evaluate the height 5 meter to 25 meter over the ground/soil plane. Frequency modulation is resulted from a Voltage Controlled Oscillator [VCO] and ramp wave input of 2 KHz wave period. VCO functions smoothly/linearly for the range 55MHz ~130MHz. At the conclusion of transmitter segment, VCO output to light power is converted by a laser driver. At the receiver portion, the APD (avalanche photodiode) photo-detector collects the back spread light. For maximum and minimum allowable distances, the maximum beat frequency and minimum beat frequency can be calculated as:

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Maximum Beat Frequency

F_b = 4(Modulation Frequency Bandwidth)(Max distance) (speed of light) (Period of ramp)

$F_b = 4(\Delta f)(d_{max}) / (c)(T_{ramp})$ =50 KHz (for 25 m distance)

Minimum Beat Frequency

F_b = 4(Modulation Frequency Bandwidth)(Min distance) / (speed of light)(Period of ramp)

$F_b = 4(\Delta f)(d_{in}) / (c)(T_{ramp})$ =10 KHz (for 5 m distance)

A band pass filter (BPF) having cut off frequency lesser than 10 KHz and higher than 50 KHz is required. The remaining is the IF signal. The beat frequency is measured out of the transition zones for which a time delay is required to receive the transmitted signal. After the filtering, for converting the beat frequency into the distance ,it is routed by the range finding algorithm in which ,the established data/signal is tied to the F/V conversion outfit intended for the readability/understanding of micro-controller/range finder algorithm. ADC translates the received data into 8 bit structure sequentially. The micro-controller/algorithm functions for such numbers/data, till the instant any alteration /progression of either voltage or current is accomplished in the course of exposure by the programmable peripheral interface. Subsequent to necessary filtering, the assorted signal is generally passed through one or more additional mixing stages for achieving low distortion. Later on such signal is compacted/detected incorporating amplification phenomenon. An appreciable vibrant range 70 to 80 dB by linearity of ± 5dB to ±1.5dB is required for logarithm amplifier stage. After compression, the signal is passed and processed by Analog to Digital Converter. After this, the data is routed through a micro-controller/range finder algorithm for ultimate determination of the required information. Such system is strongly applicable in autopilot vehicles.

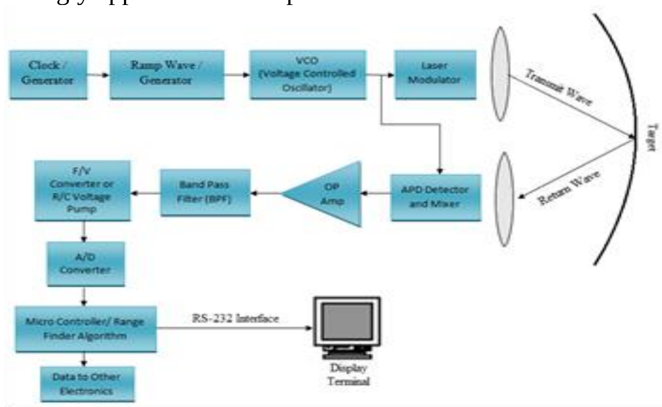

Fig 13: stature fasten system

CONCLUSION

A simple scheme of detection/location /measurement in the light of laser technology has been evaluated after having studied the other existing techniques in this regard. This scheme appears to be useful to get appropriate measurement accuracy in adverse environments. Although a very simple model is deliberated, yet it still gives the easy way of ranging. Future work will focus on improving the approach so that it can be adopted for a more practical real time situation.

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