

Processing Algorithm and Data Acquisition for Laser Range Sensor

M. Lakshmi Raviteja, N. Nagaraju, Anandbabu Gopatoti, N. Paparao

Abstract: This research paper focuses on the use of Defense, Military, Space and Industrial applications for data acquisition. Towards the development of this project is to develop processing Algorithm and Data Acquisition for LASER range sensor. All processing logic will be implemented using VHDL. The Processing logic will be implemented in serial interface 1553 from bus controller. Subsequent to range measurement it provides the range data through 1553 interface to bus controller. As part of data Acquisition the serial communication between bus controllers to remote terminal via 1553 interface will be implemented in C language.

Keywords: 1553 Interface, Bus controller, Remote Terminal

I. INTRODUCTION

For data acquisition from sensor to PC there should be required an interface module MIL-STD 1553B. It describes the time period time division multiplexing as communication information from number of signal sources through single channel communication system with segregated the sample signals in time domain to form a composite pulse train. The information can be exchanged between different flight modules in a single exchange media, for the correspondences the middle of the unique flight boxes taken area at diverse minutes on time, henceforth run through division. Interface module 1553 mainly we are using to transfer the data, easy to add remote terminals, low weight, easy bus installation and even if cable crash it can communicate dual redundant bus and it is provide back up for data. Its provide high reliability, ability to detect the communication errors and ability to retry on error. We see all those crashing compelling reason for the improvement of a information bus, Furthermore its applications, it precisely may be MIL-STD-1553B? An outline of the aspects for MIL-STD-1553B will be discovered on table 1. Those basic roles of the information transport may be to transmit information between bootleg boxes. How these boxes would joined and the strategy with those correspondence is proficient may be national of the operation of the information transport.

Table 1. Summary of MIL-STD-1553 Characteristics

Data Rate	1 MHz
Word Length	20 bits
Data Bits / Word	16 bits
Message Length	Maximum of 32 data words
Transmission Technique	Half-duplex
Operation	Asynchronous
Encoding	Manchester II bi-phase
Protocol	Command/response
Bus Control	Single or Multiple
Fault Tolerance	Typically Dual Redundant, second bus in "Hot Backup" status
Message Formats	Controller to terminal Terminal to controller Terminal to terminal Broadcast System control
Number of Remote Terminals	Maximum of 31
Terminal Types	Remote terminal Bus controller Bus monitor
Transmission Media	Twisted shielded pair
Coupling	Transformer and direct

Table 1. The characteristics of MIL-STD-1553B

Information transport may be used to process a medium for the compatibility of information. What's more majority of the data between diverse framework it may be close to the thing that the individual check and working environment mechanization industry. Similarly as multiplied An neighborhood it depict the noticeable part that aggravate the transport protocol including those message formats expressions kind summon status expressions. Military standard 1553 interface is a dual redundant data bus maximum of 32 remote terminals may be attached to military standard 1553 bus. We get it the crashing compelling reason to that advancement of a information bus, Also its applications, it precisely will be MIL-STD-1553B. In this task another distinction the middle of the two coupling routines is the period of the stub. To those direct-coupled procedure, those stub haul may be little with a most extreme from claiming you quit offering on that one foot. To the transformer-coupled method, the stub might make up to a twenty feet long. Henceforth to direct-coupled systems, that information transport must a chance to be routed previously, close to vicinity will each of the terminals, while for a transformer-coupled system, that information transport might be up to twenty feet out from each terminal.

A. Laser Transmitters for Space Applications

A laser that emits light through An methodology about optical intensification In view of the invigorated emanation for electromagnetic radiation. The expressions laser infers as a acronym for. "Light Amplification by Stimulated Emission of Radiation". A laser emits light coherently. Spatial coherence enable and laser pointers also

Manuscript published on 30 January 2019.

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allows a laser to be focused to a tight spot, laser beam to stay narrow over great distances (collimation) and have high temporal coherence, with a very narrow spectrum. Temporal coherence can be used to produce pulses of light as short as a femto second. Now redesign a Laser Optics Module (LOM) and Laser Electronics Module (LEM) module for space application is a challenging task [5].

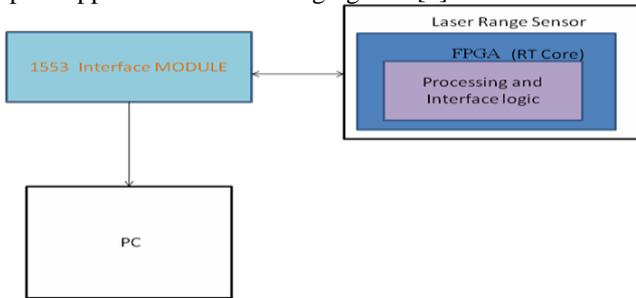


Figure.1. Block diagram of 1553 interface Data Acquisition from Sensor to PC From the laser range sensor, the data which is given to range processing logic (FPGA) as shown in figure 4.1. The laser range sensor which acts like a remote terminal and sends the data to the on board PC via 1553 interface module. The PC which acts like a bus controller and to communicate between pc to 1553 Module is implemented in c language .The C language which can be executed in visual studio software To acquire the data from sensor to pc, the sensor which acts as remote terminal and to send the data to bus controller via 1553 interface and all this processing logic is implemented in VHDL language. The VHDL language which is executed in libero software.

II. IMPLEMENTATION OF DATA HANDLING INTERFACE BY USING 1553

Interface between sensor and on board pc For data acquisition from sensor to pc, there should be desired an interfacing module for data acquisition we are using 1553 interface Hardware Elements Mil -STD-1553 depicts specific features in regards the outline of the information transport framework and the dark boxes with which those information transport may be joined. A box may be Bus controller, Remote terminal or Bus monitor. One way to attach our boxes to bus via a coupler. Line couplers which offer low weight and high reliability. Attach to the cable can be number of boxes that make up our system. If cable cut or crash is happened, by using 1553 we can overcome that problem that is dual redundant bus Even if bus controller lost or crash ,there is a solution by using 1553 that is back up bus controller. That standard characterizes four fittings components. These are communication media, remote stations, transport controllers also transport screen.

A. Protocol

The requests under which transmissions happen would allude to concerning illustration “protocol”. The control, information flow, status reporting, Also management of the transport would gave toward three expressions sorts. Three unique saying sorts need aid characterized Eventually Tom's perusing the standard. These need aid summon words, information expressions Furthermore status expressions. Each expression kind needs an interesting format, yet all three keep up a normal state. Single expressions will be twenty odds long. The principal three odds would utilized similarly as an synchronization field, thereby permitting those deci-

pher clock should re-sync at those beginning for every new statement. Those next sixteen odds would the data field Furthermore need aid dissimilar between the three statement sorts. The most recent spot is those equality bit. Equality will be dependent upon odd equality to those absolute saying.

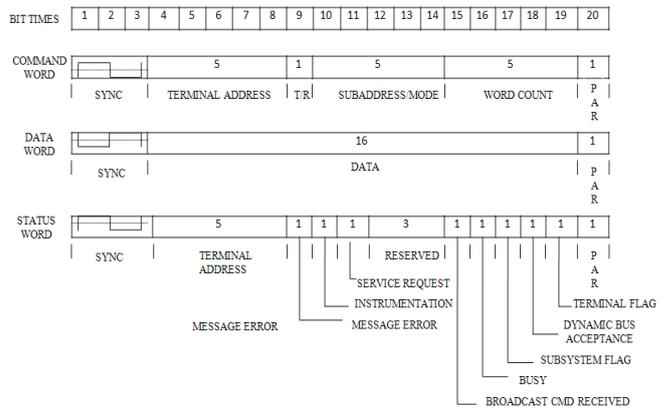


Figure 2. Word Formats

Dynamic bus control accept bit describe the status word of the Dynamic transport control acknowledgement touch (bit chance 18) advise those transport controller that those remote terminal need gather those changing transport control mode code Also need acknowledged control of the bus, those setting from claiming this bit is controlled toward those subsystem and may be dependent upon passing one level for built-in-test. Once its sending the remote terminal status word, turns into the transport controller. The transport controller, for getting those status statement starting with the remote terminal for this bit set, ceases to capacity Concerning illustration the transport controller and might start An remote terminal or transport screen. Terminal banner in the status statement characterizes the terminal banner bit (bit run through 19) informs the transport controller of a flaw line or breakdown inside the remote terminal meandering Rationale “1” ought sensible An issue state. Those most extreme touch may be those saying equality bit. Just odd equality is worn.

III. MESSAGE FORMATS

The real motivation behind the information transport may be to prepare An general networking to the return of information the middle of frameworks. Those return of information may be dependent upon message transmissions. Those data exchange formats would dependent upon the command/response logic in that every one slip allowed correspondence accepted Toward a remote terminal need aid took after Eventually Tom's perusing those transmission of a status saying starting with those terminal of the transport controller. High level class diagram of owl (object wrapper library) for mil -std-1553 interface using c language in Visual studio product Microsoft visual studio programming may be an coordinated circuit improvement nature's domain (IDE) starting with Microsoft. It develops PC projects for Microsoft windows, websites, web requisitions What's more web benefits.

Visual studio. uses windows API, windows forms, windows presentation, foundation and Microsoft silver light which are developed by Microsoft .It can create both native code and managed code visual studio supports and allows different programming languages provided with language specific service ,code editor and debugger. C, C++,Visual Basic. NET,C# and F# with are built in languages and also Different dialects for example, such that , Python Also ruby dialects would accessible by means of dialect administrations introduced independently. The OWL for 1553 is broken up into several modules. These model the logical components of a MIL-STD-553bus. IBoard defines a board represent a physical board available on the system. These boards are created by the Iboard factory. Boards can execute self-tests, and retrieve board-level information. They are also the source of MIL-STD-1553 channels. A channel represents are Dunant link toal553 bus. It includes the primary and secondary links to the bus and can be configured to run in either1553 A or1553Bmodes.

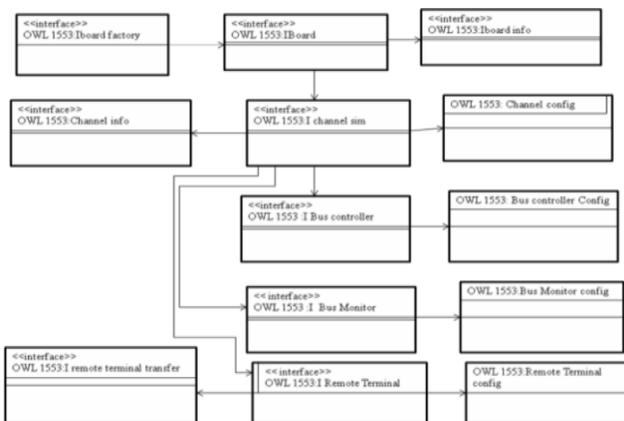


Figure.3. High-Level Class Diagram

VHDL code used for remote terminal to bus controller communication in libero software Actel’sLibero IDE offers those most recent and best-In population instruments starting with heading adrift EDA vendors for example, coach graphics, synaptic promotion Furthermore Straightforwardness. Creator will be accessible similarly as a standalone product, for the individuals who need to use their outline Also confirmation tools, Libero IDE offers.

Functional Block Diagram of Remote Terminal to bus Controller Communication

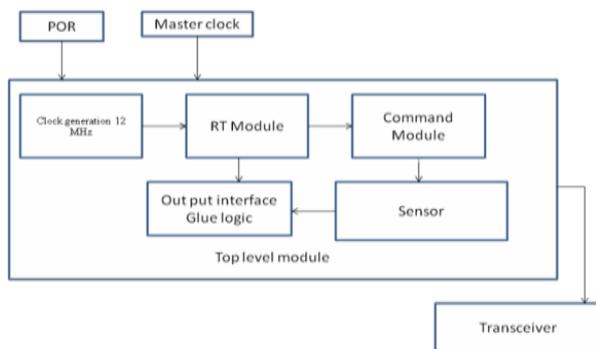


Figure 3.1. Functional Block Diagram of RT to BC Communication

The input clock is given to the clock module andgenerates12 MHz clock and the corresponding block diagram as shown in figure 3.1

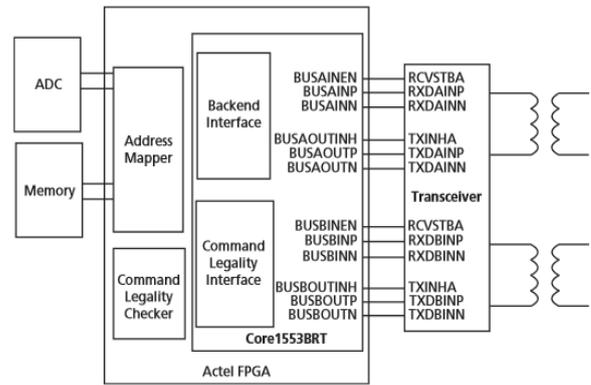


Figure 3.2.Core1553B RT System

The 12MHz clock is given to the RT module core 1553 BRT Gives An complete, dual-redundant MIL-STD-1553B remote terminal (RT) a part from the transceivers obliged on interface of the transport. A typical framework usage utilizing the core 1553BRT as shown in figure 3.2.

The signals which are given to the RT module are control signals, status signals command legalization interface and backend interface signals. Toward a helter skelter level, center 1553BRT essentially gives a set from claiming memory mapped sub-address that get information composed will 'or' transmit peruse from [14].

IV. RESULTS

Timing diagram of Serial Data Command Interface when the 16bursts of clock pulse is given, with some delay the 6 commands will be transfer and after that transfer transfer pulse will be send to know that all the data has been sent. Channe 12 have RT in transformer coupling mode and number of channels represented the how many channels are present in the bus and the bus controller message count is1defines that Bus controller is sending the.

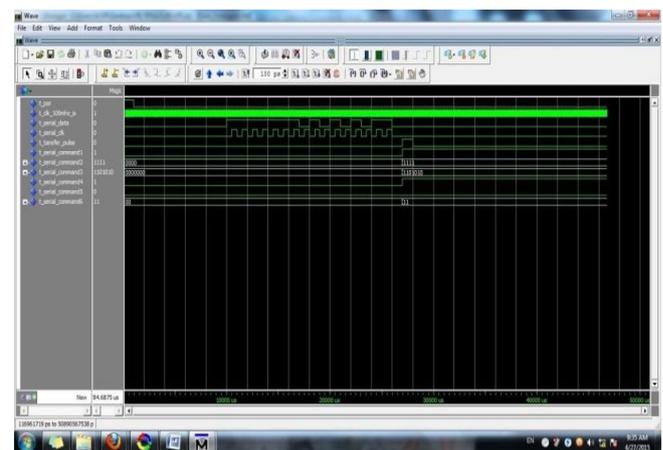


Figure .4. Timing Diagram of Serial Data Command Interface

When the clock pulse is given, the data update denotes that the data from the sensor is ready and the mode pulse which denotes that it starts to read the data and the count pulse which denotes that it starts the counting of the data for every single pulse

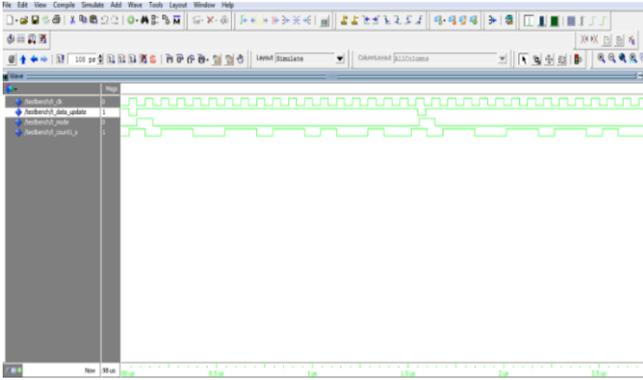


Figure 4.1. Timing Diagram of Data Handling Interface

Data read from the bus comes in the form of messages. A message is a complete transmission between a bus controller or remote terminals. All commands and status words available per message. Board serial number represents that the configured channel1 is have BC and number of messages and the error count is zero defines zero errors and the sending of data was successful. Remote Terminal message count defines the number of messages it is receiving from bus controller. Remote Terminal 5 represents the terminal address and sub address 5 which represents the any other sub system or sensor. Word count defines the number of words it is coming from Bus controller to Remote Terminal. Data which represents that the data is sending from BC to RT. Status word which comes output as 0X2800, that means only remote terminal address field in status word gets enabled remaining all tends to zero.



Figure 4.2. PC to Transfer Simulation Output using C language in Visual Studio Soft Ware

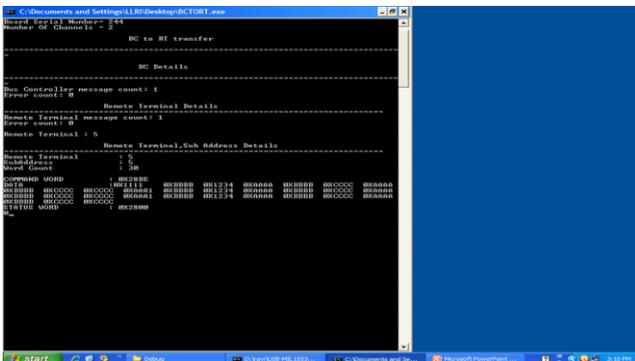


Figure 4.3 PC to Transfer Simulation Output using c language in Visual Studio Soft Ware

Command module output for RT to PC communication in libero software using vhdl language The clock signal of 12MHz signal is given to command module which is syn-

chronous and the power on reset signal which is given to the command block, if the power on reset signal is zero and it is given to the command block, then remaining signals will be inactive state and the memory write (active low) state which is given in synchronous mode and this output indicates that data is to be written on the rising clock edge. The memory write address (active low state) and the out which indicates that memory data output (active low state), whatever the data is present it comes in state indicates that Memory receive command and the sub address which indicates that sensor or subsystem address and the in out dives helter skelter when those information need been accepted or transmitted or An mode summon transformed. There Concerning illustration ahead to those intrude will be furnished around INTVECT. This yield will remain helter skelter until INTACK dives secondary. If INTACK will be held high, this yield will pulse secondary to an absolute clock cycle and correspondingly the data command which are given to a sensor. The commands 2 to 6 which is given to internal module of a sensor [11].

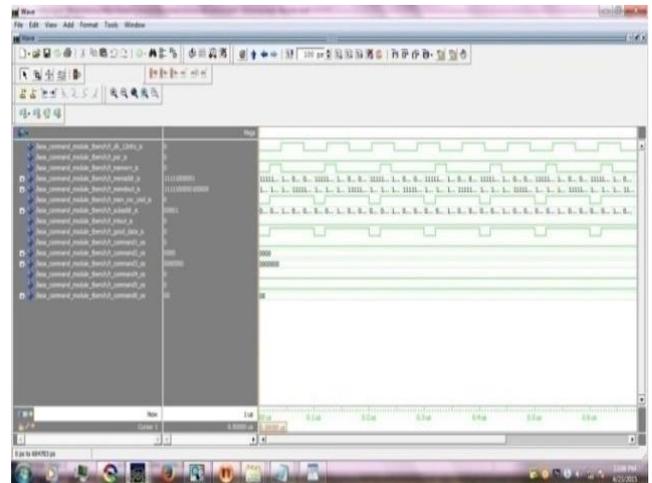


Figure 4.4. Command Module Output for RT to PC communication in Libero Software using VHDL Language

Sensor module output for RT to PC communication in libero software using vhdl language whenever, the command comes from sensor, the laser pump pulse will start firing correspondingly. The start signal indicates that it sends to the target, whenever the laser pump pulse will starts and the stop signal indicates that it get the reflected signal from the target. The time duration between start and stop signals indicates as T12 and the count signal which is active of time T12 and count the data. The power on reset and clock which is given +to output interface module. Delayed the register write signal to the falling edge of the clock if power on reset signal is zero then load data register is equal to zero. Check for register update during 1553B transmit and write the data after memory reading completed and form at the output as telemetry format and if the memory transmit command is low and if the memory read (active low logic) is low transmit data from the registers to the corresponding register named as read data os.

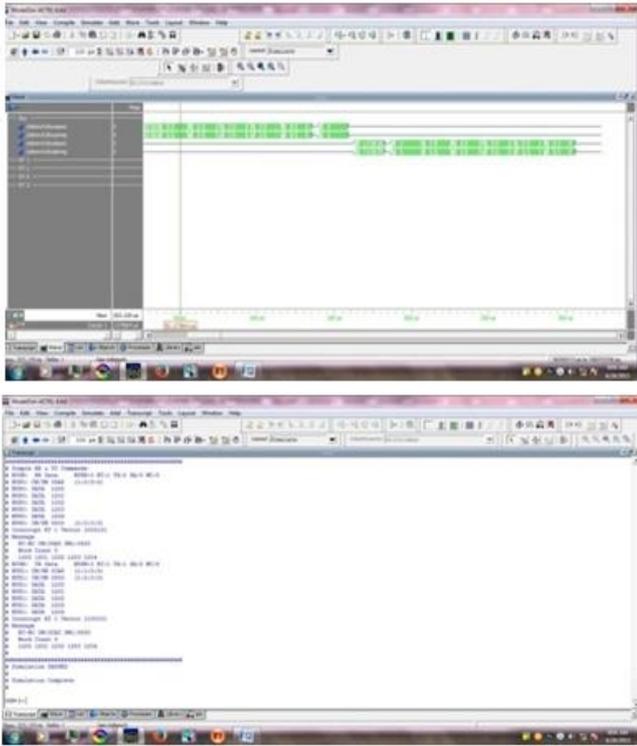


Fig.4.7. Wave window and Transcript

V. CONCLUSION

An overview of laser sensor system is presented in this project. The laser and detectors used for different types of laser range finding techniques are discussed. Implementation of processing scheme and interfacing logic is completed for laser range sensor being developed at LEOS-ISRO for lander application and docking application. Logical circuits for processing scheme that consists of time digitizer and analog interpolator is designed. Two Sensor interfacing techniques—serial interface [14] and mil-std-1553 interface are developed. Either of the interface schemes is selected depending on the application. The interface is developed in VHDL for FPGA implementation. Additionally, for 1553 test console,(software based on code)is developed to simulate the communication between BC to sensor system for ground testing of the system.

FUTURE SCOPE

In advanced it can be useful for all kind of industrial applications, security purpose like Military, defense and space. Data Acquisition for laser range sensors using serial interface bus controller. Data communication or data acquisition the serial interface between bus controller and remote terminal. This can be mainly used for to provide high security of data communications

REFERENCES

1. Farzin, Amzajerdian, Diego Pierrottet, Larry Petway, Glennhines and Vincent Roback. "LIDAR Systems for precision navigation and safe landing on planetary bodies",SPIE Defense and Security Symposium, Orlando, FL,(2011).
2. F. Amzajerdian, D. Pierrottet, L. Petway, M.Vanek," Development of LIDAR sensor and LASER systems for autonomous safe landing on planetary bodies".
3. Amzajerdian,Fazzin,pierrottet,Petway,LarryB,Hines,alennD,Roback,VincentE,

4. "LIDAR and LASER systems for precision Navigation and safe landing on planetary bodies". Langel Research centre .NASA.
4. Graham Brooker, "Introduction to Sensors for Ranging and Imaging", Scitech Publishing,2009".
5. LASER/ Electro –optics Technology(LEOT), "New Design and Applications for LASERS".
6. V.E. Kisel and V.G. Shcherbitskii. (2005), "Passive Q switches for a diode-pumped erbium glass laser", Quantum Electronics 35(7) 611-614
7. M.M. Michaelisand A. Forbes. (2008), 'Lasers in space', Proc. of SPIE Vol. 7005
8. J.A.Kamalakar, KVSbhasakar, A.S.Laxmiprasad, R.Ranjith, K.A.Lohar, R.Venkateswaran and T.K.Alex, "Lunar Ranging Instrument for Chandrayan-1".
9. V.L.N Sridhar Raja, V.S Bhaskar, A.S.Laxmi Prasad and J.A.Kamalakar "Solid-state Lasers for Space Applications".
10. V.L.N Sridhar Raja, A.S.Laxmi Prasad and J.A.Kamalakar "Performance characterization of Si-APD for space Applications".
11. Bhavana Godavarthi, Paparao Nalajala, M Lakshmi Ravi Teja," Wireless Sensors Based Data Acquisition System Using Smart Mobile Application", International Journal of Advanced Trends in Computer Science and Engineering, Volume 5, Issue 1, January 2016
12. K.Kalyani, V.L.N Sridhar Raja, AdwaitaGoswami, K.Ravi Kumar, K.V.S Bhaskar ,P.Selvaraj, R.Venkateswaran,A.S.Laxmi Prasad and J.A.Kamalakar "Design and Performance Aspects of Lunar Laser Ranging Instrument".
13. Actel "1553B RT FPGA core Data sheet".
14. Paparao Nalajala, Bhavana Godavarth, M Lakshmi Raviteja, Deepthi Simhadri," Morse code Generator Using Microcontroller with Alpha-numeric Keypad", International Conference on Elec-trical, Electronics, and Optimization Techniques (ICEEOT), Pages 762 – 766,Publisher-IEEE