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PLATFORM INDEPENDENT SIMULATION OF INSTRUMENTATION PARAMETERS FOR UNDERWATER VEHICLE APPLICATION

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ABSTRACT

In application like Under Water Vehicle (UWV), it is essential to monitor various subsystem parameters during development stage of the vehicle. In case of UWV, performance evaluation is done offline post-trial because it is impossible to transmit data from vehicle either by cables or wireless while underwater. This calls for onboard recording system to record different parameter for different subsystems and download data for offline processing. Integrated Instrumentation and Recording System (IIRS) is developed for purpose of data acquisition, storing and generating alarm in UWV. This instrumentation system is calibrated offline during system integration check using a combination of software and hardware.Simulation environment is designed using personal computer interfaced with MIL–STD-1553B along with IIRS unit.

***Keywords*:**Under Water Vehicle,Missile, Integrated Instrumentation and Recording System, MIL- STD 1553B protocol.

1. Introduction

Every appliance has its own instrumentation system which is used in the process of measuring and controlling various tasks done by the appliance. In computer terminology instrumentation refer to measure the product's performance, diagnose errors. Programmers implement instrumentation in the form of code that can monitor the overall performance and can be used to appear the output information on the screen. In application like flight control System, Missile, underwater vehicle etc., also have instrumentation system to monitor the performance of the vehicles. Under water vehicles are mainly categorised into two, Remotely operated underwater vehicle (ROV) and Autonomous underwater vehicle (AUV). Remotely operated underwater vehicles are controlled by a remote human operator. Autonomous underwater vehicles require continuous acquisition of data with regards to the performance, storing of acquired data and decision-making capability during abnormal conditions without human intervention. The instrumentation system in these vehicles is responsible for communication between different sub-systems in the form of messages using MIL-STD 1553B. This paper emphasizes on designing simulation

environment for offline calibration of Integrated Instrumentation and Recording System (IIRS). The simulation environment is designed using both software and hardware.

The purpose of this work is to develop a simulation medium which is independent of platform and can be user friendly. Two methods were proposed in this project: simulation based on software and evaluation of entire environment using software – hardware testing environment. In this paper, mainly focus on Analog/Discrete Data simulation,Serial communication for online Monitoring, MIL-STD 1553B Data Simulation.

Number of component is reduced and degree of integration is increased because of the combination of MIL-STD-1553 transceiver and transformer into single FPGA device. Due to reusable IP core feature the manufacturing cost is also reduced [1]. Design and implementation of underwater survey mission that can detect and map the obstacle during vehicle run [2]. Simulation programs are transformed into java programs. The simulation programs can automatically generate Real time control programs by using Factory method pattern [3].

The composition of this paper is as follows. In section II, design and implementation of proposed system weredescribed. In section III, we evaluate and analyzeperformance of proposed system. In section IV, we discussabout conclusion and future work.

2. Designand Implementation

The objective is to develop a platform independent simulation environment by using DLL files. The generated simulation software can run on any operating system with minimum or no changes in the code or directly accessing the object file for execution, so that software is secured and provides reliable data. The proposed work is divided into three modules.

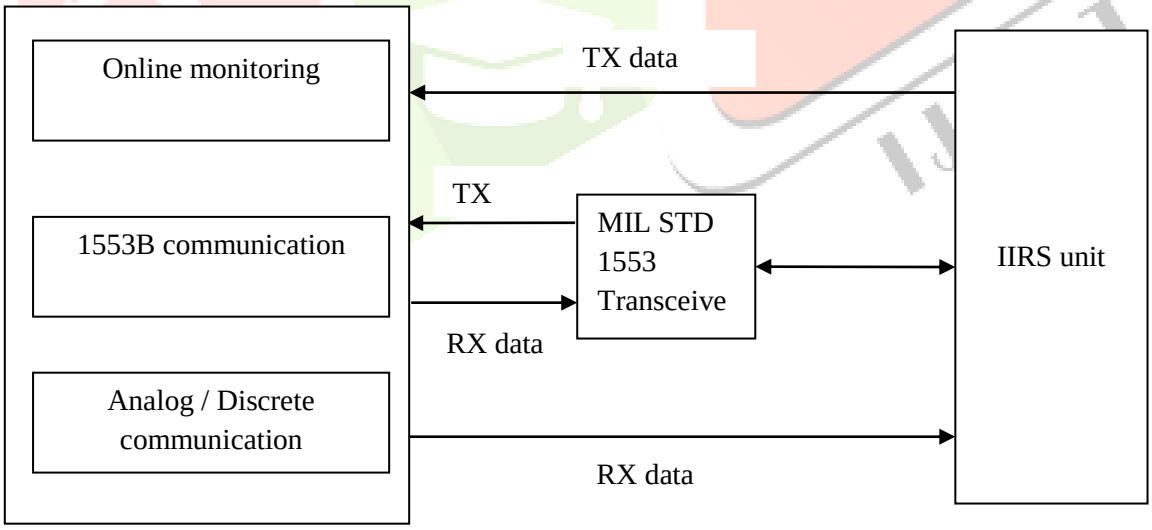

Fig.1 : System architecture

2.1: Module 1: 1553B communication

In the first module we implement 1553 data simulation between the IIRS unit and PC. For this we use 1553B add-on card which is responsible for the communication between the IIRS unit and PC. Add-on card is accessed using MIL- STD 1553B protocol. MIL – STD 1553B is a time division multiplexing, half duplex communication i.e., only one transmission signal is transmitted in one direction at a specified time slot.

In this module we use 1553.dll file to activate the 1553 add-on card as Bus monitor. Using this .dll we configure Bus controller and IIRS unit as one of the remote terminal. The figure shown below explains the message frame that is send to the IIRS unit.The message frame has following parts:

- Each message of 128 bits has a unique message number of 16 bits
- The message of 64 bits consists of Remote terminal sub-address, word count, transmit or receive, Remote terminal address,Bus channel A/B, inter message gap i.e., minimum pause required between packets.
- The data that is transmitted in every message frame is 32bits.
- Word count of 16 bits.

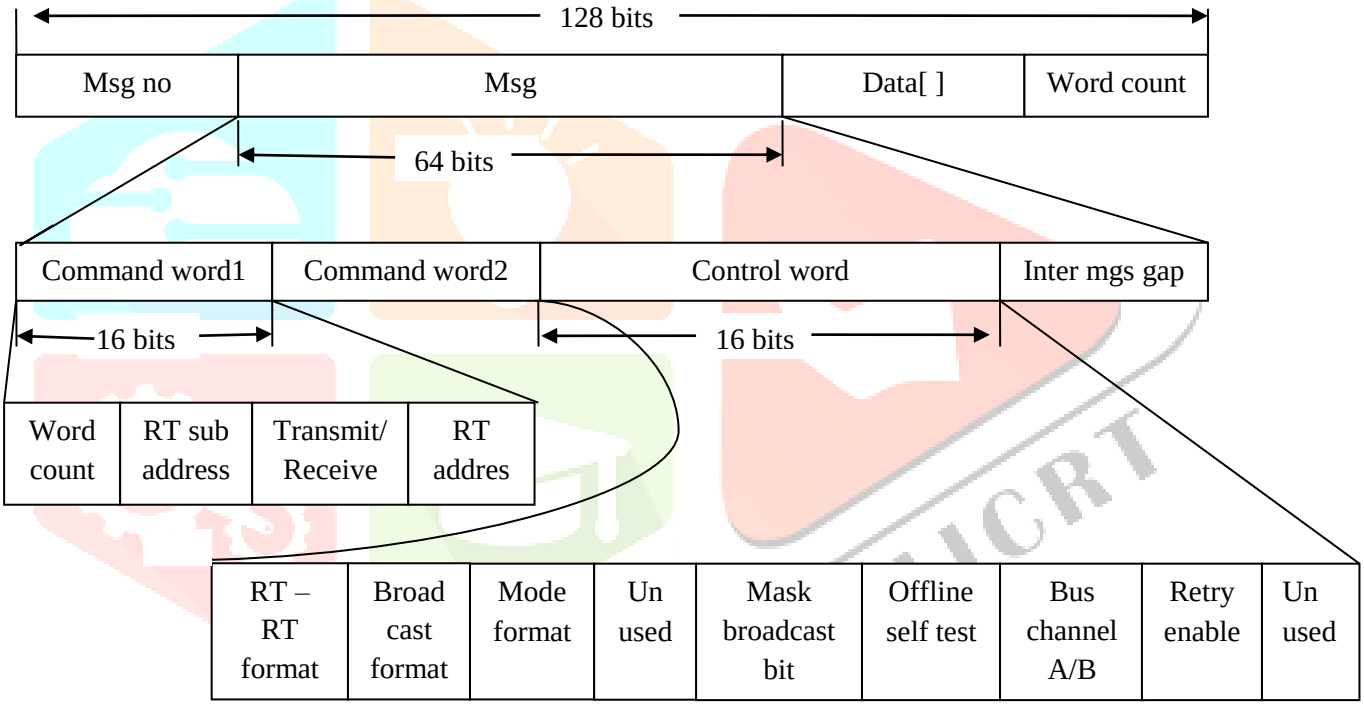

Fig.2 : 1553B message format

2.2: Module 2: Analog / Discrete communication:

In the second module we implement communication between IIRS unit and simulated subsystems in PC. This communication is done using 1553B communication channel. The data is sent in the form of Analog/Discrete signals.We use PCI DACIO add-on card for communication. Transistor -Transistor logic(TTL) signals are used for discrete signals. These transistors can perform both logic function and amplifying function. These logic signals are widely used in electronic instruments at input and output. One of the features of TTL signal is, if left unconnected the ability of the input gate raise to logical “1”.

In this module we access PCIO.dll file that implements hard ware operations like operation O/P, reading I/P. PCISPL.dll file that helps DLL manages the interaction of application mode program with kernel mode driver.

2.3: Module 3: Online monitoring

In the third module we implement a serial communication between IIRS unit and PC. For this we use RS232 serial communication protocol to establish communication. The data is transmitted bit by bit asynchronously. The messages that are sent to the IIRS unit are acknowledged, stored and then send to the PC to monitor. In this module we just monitor the data that is stored in the IIRS whenever the messages are transmitted form simulated subsystems.
All the modules are programmed using java language, and are finally integrated into single application.

3. Performance and Results:

A simulation environment is constructed for verifying performance of the IIRS unit. The simulation environment is shown in Fig.1.

At first we start the check for the port connections and the pin configurations on the 1553 add-on card and PCIOD add-on card. We connect the IIRS unit and the PC using 1553B cables and RS-232 connector.

Using 1553B.dll we initiate 1553B add-on card and then select a desired 1553B module on target 1553 add-on card, next we configure one of the module as remote terminal in enhanced/normal mode another module as bus controller in enhanced/normal mode.th module configured as BC is used to schedule messages that contain message number, command word, inter message gap, control word, holds data to be send and word count. We define a frame of messages to be sent over 1553 bus. It gets passed the number of messages in the frame and an array that defines the sequence of the messages to be sent over the bus. If more than 64 messages are defined, an error will result and be returned as function value. After the simulation is ON we start the water contact for IIRS unit. Then run the add-on card in bus controller mode, assuming the message and frames are defined. It gets passed the frame, position in frame to start at, number of messages in frame and number of time to run the frame. If end of frame is reached before the defined number of messages, an error is returned a function value. The unit start recording once the depth increases to 10ft. When there is a change in any of the subsystem, the modified data is transmitted in the form of frames through 1553B bus channel A/B to the IIRS unit as Analog signals. Then the unit stores the modified data in the memory card.

Using PCIOD.dll we initialize the internal variable and establish connection between card and IIRS unit. We can transmit Discrete signals in the form of transistor - transistor logic signals or SSR signals. So that only when the input voltage is high [logic “1”], data is transmitted.

We use RS232 serial communication to monitor the transmitted data. For this we read the stored data in the IIRS unit. Data updates for every 10ms when ever serial port receives data.

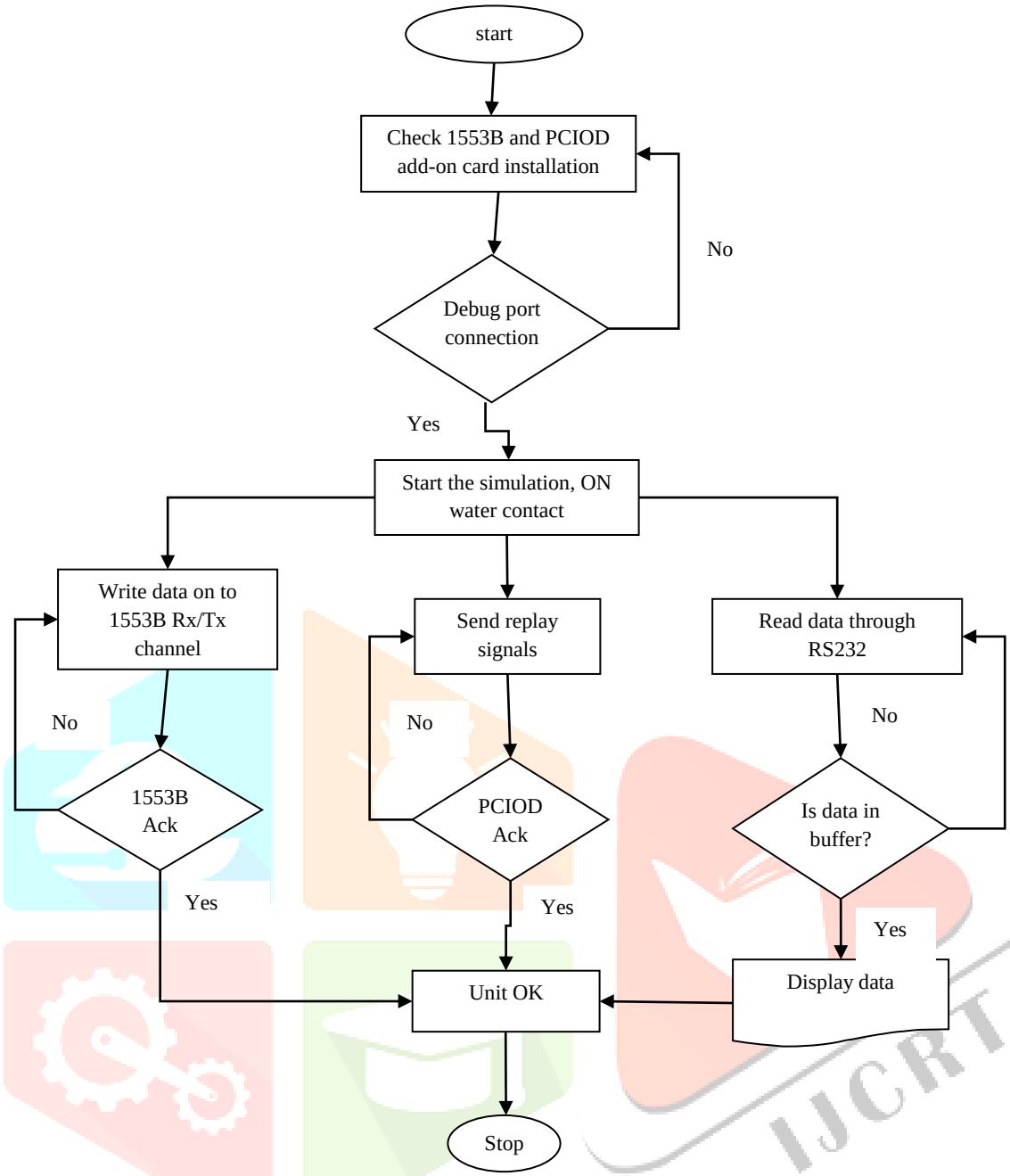

Fig.3 : Flowchart of implementation firmware

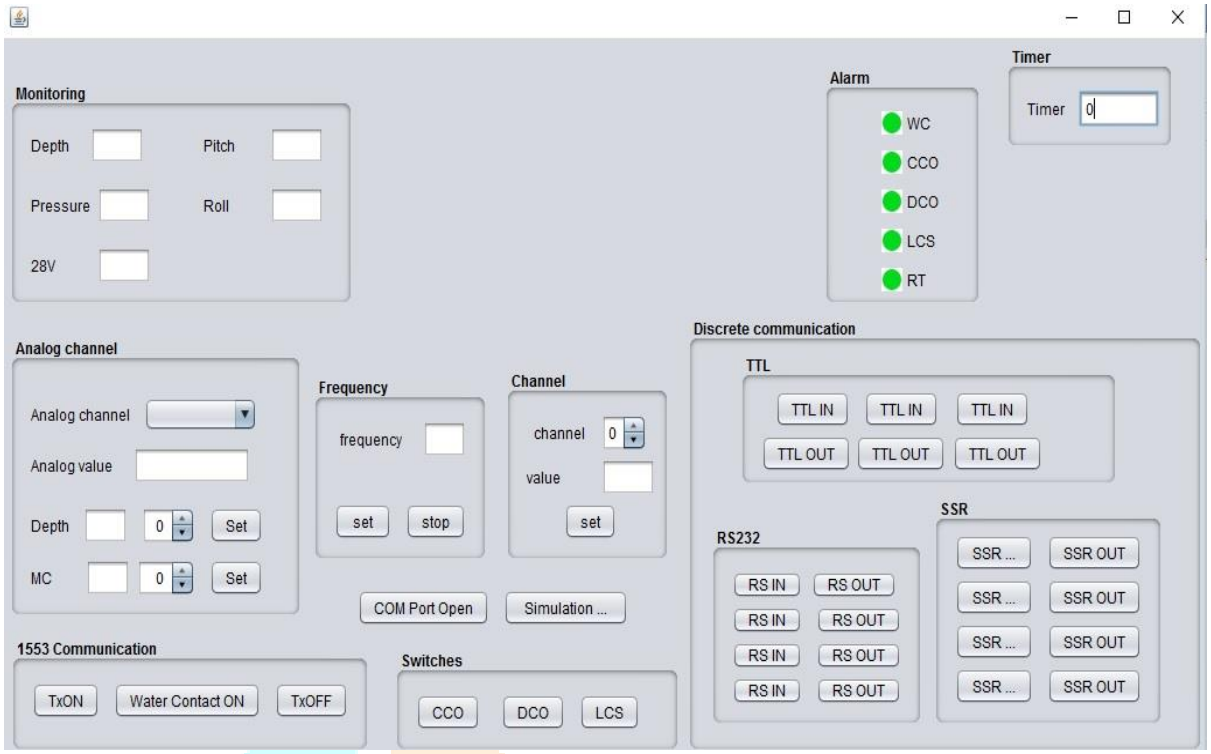

Fig.3.1: simulation of instrumentation parameters

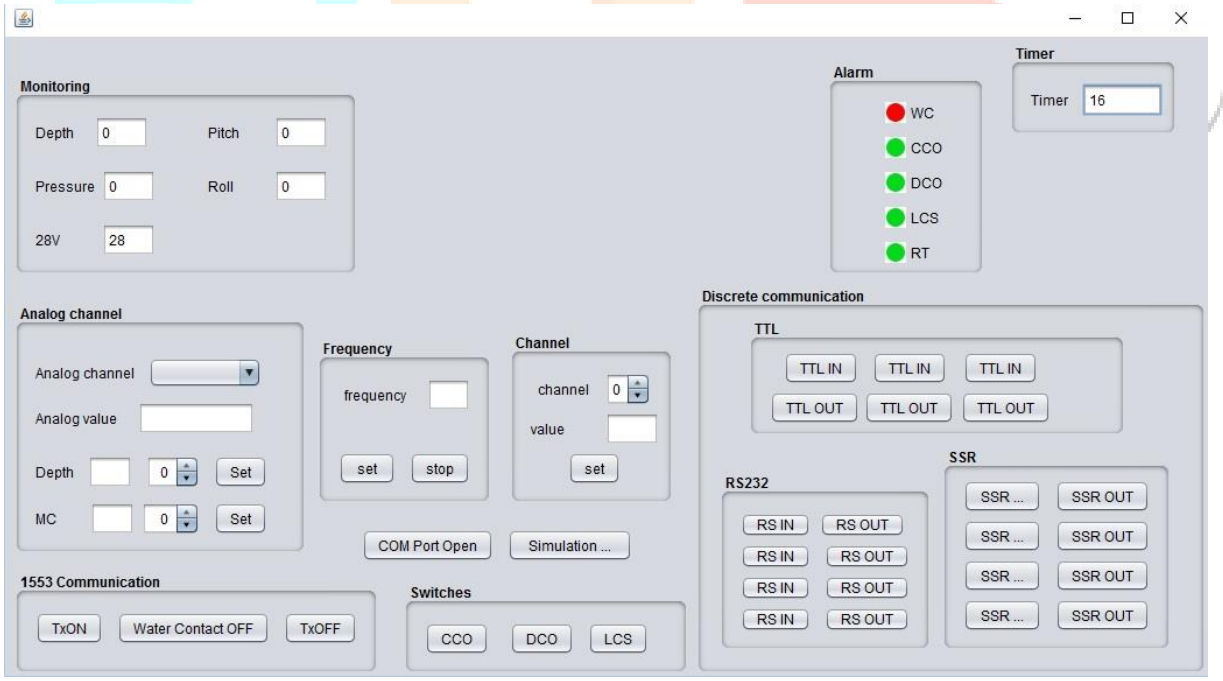

Fig.3.2: Monitoring data

4. Conclusion

In his paper, we propose design and implementation of platform independent instrumentation simulation of MIL STD 1553B for military system requirement. The one – one data communication with BC and communication function between RTs were tested and analysed using prototype of RT subsystem. Advantages of the simulation system are as follows

Firstly, the simulation environment is programmed in java that can run on all operating systems. This language is human readable, that can be understand buy any user. Secondly, it can overcome the

compatibility issue during migration to another operating system. Thirdly, the proposed technique is easy to maintain, and can include new modules.

In future work we will study, the performance of the environment in Linux OS.

5. References

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