Automation of Calibrating and Configuring the Smart Transmitters Using HART Management System and Template Creation Using Labview

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Abstract -- Transmitters are being used for measurement and testing purpose. Prior to major testing, the sensor values from the Transmitters have to be manually simulated for verifying channel integrity. HART communication is introduced for Smart communication in order to reduce the human error and preparation time. Bidirectional HART communication provides access to additional information between the field devices and the host controller which can be developed using HART protocol, MTL4840–HART connection system, Smart Transmitters. The PC with LabView software is connected to the HART communication system to have an automatic performance evaluation and the HMS(HART Management System) will be connected with the barrier to the Data Acquisition Server(DAS), So that more than one system can have the display node of the Transmitters. The template creation using the values taken from the HART system and the DAS must be done for Configuring. Developed system will drastically reduce the preparation time and avoid human error.

Indexed Terms: HART protocol, HMS, backplane, Lab VIEW, Data Acquisition Server, HMS-HART Management System

I. INTRODUCTION

The MTL4840 HART System enables to calibrate, configure and maintain a Smart Transmitters from a single PC. [1-3] The HART communication system with the handheld device is the existing protocol used for evaluating the Transmitters [4-6]. But using the handheld device for the HART communication can lead to manual errors because the 4-20mA testing signal is send by a human. Also, the evaluating time is about 5-7 days for 50 channels. So the work of the handheld device is replaced by the Lab VIEW Application with HART protocol [6] to automate the performance evaluation. The PC with Lab VIEW software is connected to the HART communication system which is connected to the Transmitters [5] The Data Acquisition system consists of a server and client (display node) along with the DAS server. The values got from Labview and DAS are compared for accuracy. First the Transmitter ID for the 8 Transmitters are found. The Data acquisition process is most important because the Transmitter values are send to the server for monitoring. The channel name and the channel value to which the Transmitters are connected are displayed in the Display node. The loop test must be done with all the Transmitters connected. A template must be created for the loop test done with the 8 Transmitters. Once the Lab VIEW program is initiated the automatic performance of the Smart Transmitters is done without any manual errors. Also the testing time is reduced drastically. The evaluation is done within 5-7 hours [9-10].

II. PROBLEM IDENTIFICATION

Hart Communication System having Hart devices without Lab VIEW Software configuration. So the field devices are controlled by the handheld terminal. HART Communicators offer the tool for communication with method instruments. relying on associate degree open protocol, HART communicators interface with HART-enabled “master” and “field” devices creating it abundant easier to set up and calibrate instruments similarly as diagnose problems before they become serious [2]. As a full function HART communicator, the DHH805 supports Universal, Common Practice, and Device Specific commands for commissioning, configuration, and maintenance operations [3- 4]. In order to do testing, the transmitters ID have to be identified and the current value in the transmitter have to be noted continuously. So this is done using the HART handheld device which supports the HART commands

[3]. The HART Communicator is the main tool used to communicate with the HART Devices with the Field Devices [7-8]. So every communication should be made with this communicator manually. The 4-20mA signal from the transmitter is received by the Hart devices and adjusted manually. Manual performance evaluation of the transmitters using the hart communicator takes about 5 -7 days before testing. Also manual operation leads to errors.

III. PROBLEM SOLUTION

A Typical MTL4840 HART affiliation System can carries with it the subsequent 3 elements. A HART Communication Board to produce a physical affiliation - HART Communication Unit for safe space applications or as such safe backplane for risky space applications. HART multiplexer are used to start the communication between the maintenance PC and the HART devices. HART backplane BPHM64 to hold the HART multiplexer modules. The PC with lab View software is connected to the RS232 serial communication port and the HART backplane HMM64 with master and slave Hart multiplexers are connected to the HART communication board to have an extended connection with the field devices. The Hart communication and the field devices start to communicate using the 24V power supply. Using Lab view software, the automated performance evaluation can be done. The command mode has the universal commands to find the transmitter id and the current (4 - 20mA) signal of the transmitter. Also a program is designed to send a 4 - 20mA signal to the transmitter in case of testing the transmitter. This project proposal will lead to an automatic performance evaluation of the transmitters without any manual interpretation of the humans. Also it reduces the amount of time taken for this process, so that it can be finished within a few hours. Each HART device includes a distinctive 38-bit address that consists of the manufacturer ID code, device type code and device-unique identifier. A unique address is encoded in every device at the time of manufacture. A HART master should grasp the address of a field device so as to speak with success with it. A master will learn the address of a slave device by supplying one among 2 commands that cause the slave device to retort with its address: Command zero, Read Unique Identifier, Command 11, Read Unique Identifier by Tag. After Configuring and calibrating a single Transmitter using the LabView software,8 Transmitters are connected to the PC with Labview software and configuration and calibration is done. First the Transmitter ID for the 8 Transmitters are found and then the configuration process is preceded. The Data acquisition process is most important because the Transmitter values are send to the server for monitoring. The channel name and the channel value to which the Transmitters are connected are displayed in the Display node. The loop test must be done with all the Transmitters connected. A template must be created for the loop test done with the 8 Transmitters. The loop test along with the channel name and the values will be displayed in the display node so that any node can see the template at any time.

3.1.Block Diagram

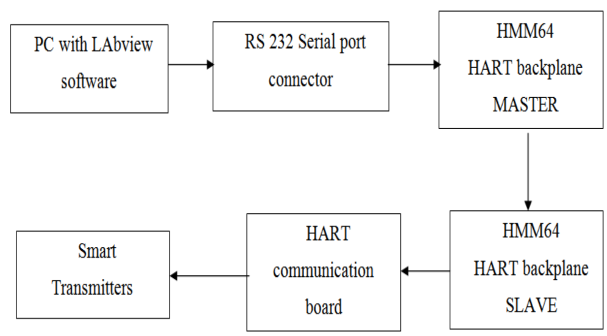

Fig3.1. Block Diagram of the HART communication

3.2. Block Description

The Fig3.1 describes the block diagram of the HART Communication in which the PC with Lab View Software is connected to the RS232 Serial Port connector to communicate serially. From there the Master HART backplane is connected to the Slave HART Backplane which will lead to communicate with the Transmitters. As we can connect more than one Transmitters HART Communication Board is connected between the HART Devices and the Field Devices to start Communication

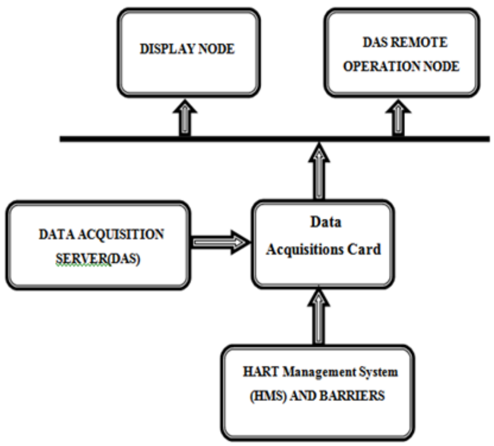

Fig 3.2. Block Diagram

The Fig 3.2 shows the block diagram of the whole project. The HMS is connected to the Data Acquisition System through the barriers, so that the datas are compared and the template is created using Labview. The datas are shared to the display nodes.

3.3. HART COMMUNICATION PROTOCOL

Delimiter	Address	[Expansion bytes]	command byte	Byte count	[Data]	Check byte

Fig 3.3 Packet Structure of HART

The Fig 3.3 shows the packet structure of the HART communication in which the Address of the HART Devices and the Field Devices can be identified.Also the Command byte helps in various activities such as Id Identification,sending current signal etc.

The Table 1 gives the information about the packet structure oh the HART.The length of the bytes in the packet structure is explained.The purpose of the bytes is explained in the Table.

Table 1 Packet Structure of HART

Field Name	Length in Bytes	Purpose
Preamble	5-20	Synchronization and Carrier Detect
Start byte	1	Specifies Master Number
Address	1-5	Specifies Slave, Specifies Master and indicates Burst Mode
Expansion	0-3	This field is 0-3 bytes long and its length is indicated in the Delimiter
Command	1	Numerical Value for the command to be executed
Number of Data bytes	1	Indicates the size of the data field
Data	0-255	Data Associated with the command
Checksum	1	XOR of all bytes from Start Byte to Last byte of Data

3.4. Hart Communication Board

The Fig3.3 is the HART communication board which helps in connection between the HART field devices and the HART backplane. A 16 channel board, accept inputs maintaining channel to channel isolation between them.

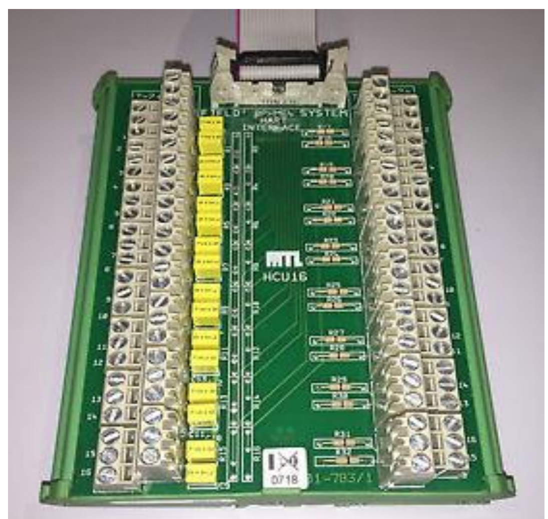

Fig 3.3 HART Communication Board

The HART connection unit provides an interface control between the field devices in non-hazardous areas and the PC in safe area. It also provides a launch point for the HART signals to the maintenance system. Connections to the field signals and the system are via screw-clamp terminals and the link to the HMM64 is through a 20-way ribbon cable.

3.5. Hart Backplane BPHM64

The HART backplane in Fig 3.4 is the backbone of the MTL4840 system. This board holds the MTL4840

HART modules which handle the HART multiplexing. Each board can correspond with up to 64 HART devices.

The MTL HART maintenance solution is capable of addressing several thousand field devices, but most real world applications are significantly smaller than this. MTL has also devised a simple, integrated solution that is proving popular for smaller installations of up to 32 devices.

Fig 3.4 HART backplane BPHM64

Each HMU accommodate one MTL4841 communications module and MTL4842multiplexer modules, each of which can hold 16 signals. This method can accommodate more signals but, depending on the amount of growth required, it would probably be better to use the method described next for more than 32 loops.

3.6. Hart Multiplexer

The MTL4851/52 HART connection system in Fig3.5 is the system of choice for unparalleled flexibility. Based on 16 channel module, the system can be easily expanded to cover up to 7936 HART devices on one network. The HART multiplexer provides the brains of the system and consists of combination of two modules, the MTL4851 - HART communications module (master) and MTL4852 (slave) - HART interface module.

Fig 3.5 HART multiplexer

They provide the HART data interface between smart transmitters in the hazardous area and HART program in the Lab VIEW software on a PC.

The modules, which accumulate on to a range of HART backplanes, connect to the field devices through either HART connection units or backplanes depending on the application.

3.7. RS232 Serial Port Connector

RS232 in Fig3.6 is a standard procedure used for serial Communication; it is used for connecting PC and the HART devices to allow serial data transfer between them. The 24V power supply is connected to the RS232 port connector to connect to the PC, so that the serial communication starts.

Fig 3.6 RS232 Serial port connector

RS232 works on the two-way communication that exchanges data to one another. There are two devices connected to each other, which has the pins like TXD**,** RXD**,** and RTS& CTS. Now, from DTE source, the **RTS** generates the *request to send* the data. Then from the other side DCE, the CTS**,** clears the path for receiving the data.

3.8. Lab View Software

Lab View (Laboratory Virtual Instrument Engineering Workbench), created by National Instruments is a graphical programming language that uses icons instead of lines of text to create applications. Lab VIEW programs/codes are called Virtual Instruments, or VIs. Lab VIEW is used for Data acquisition, signal Processing (Analysis), and hardware control a characteristic tool constitution on the basis on Lab view.

3.9. Block Description –Fig 3.2

The Fig 3.2 shows the block diagram of this project where the HART communication system is connected to the DATA acquisition System(DAS) with the PLC Network to have display nodes in more than one system. The DAS will give the channel name and the corresponding channel value to which the Transmitters are connected, so that the template can be created with both the loop test value and the DAS value.

3.10. Data Acquisition Syatem(DAS)

A server which provides database services to other computer programs or to computers. So, we can get the Transmitter information in any node. The facility DAS consists of the Data Acquisition System with the display node to run the software to get live information from the Smart Transmitters through barriers.

Fig 3.7. Data Acquisition System(DAS)

The Data Acquisition Server is connected to the Data Acquisition Card and the server Transmitter value is traced.The Transmitters are controlled by the Labview program and the datas from the server is compared using the template.The Template is displayed in the display node.

IV. RESULT AND DISCUSSION

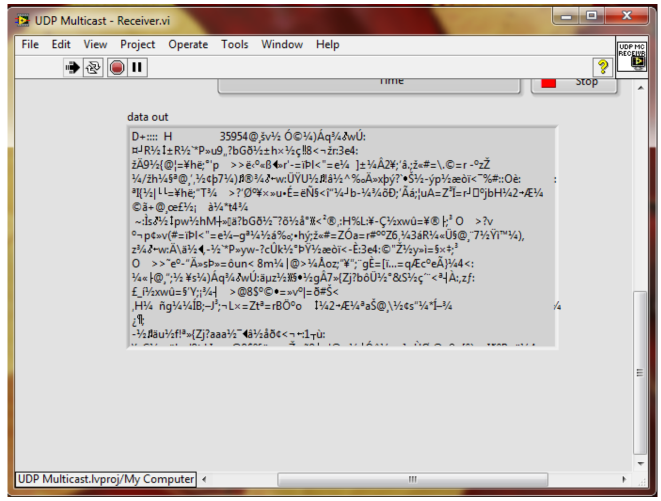

Fig 4.1 Data from Server

The data from the server is encrypted so it is first received from the server. The facility DAS consists of the Data Acquisition System with the display node to run the software to get live information from the Smart Transmitters through barriers.

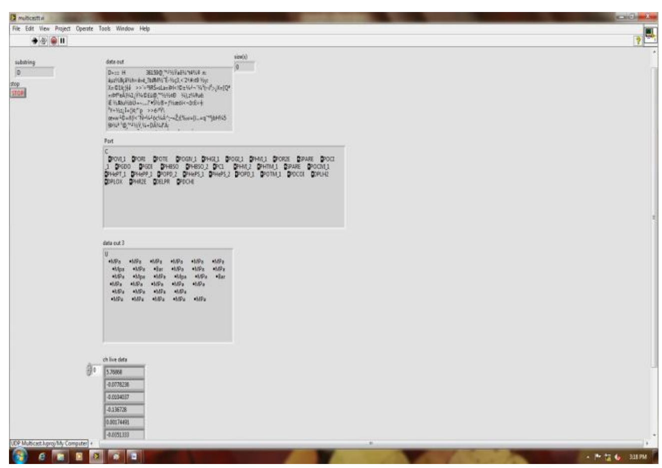

Fig 4.2 Decrypted Data

The data id decrypted using the Labview software

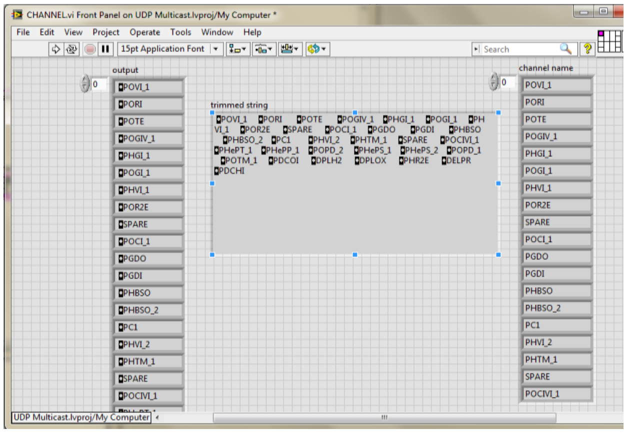

Fig 4.3 Channel name

The chaneel name and the channel value ie the Transmitter voltage value is identified.

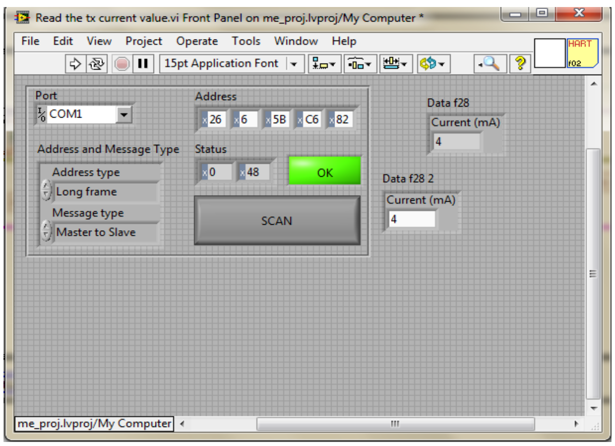

Fig 4.4 Hart Communication Result

The Transmitter loop test is done.The current value is sent from the PC to the Transmitter and the Transmitter respond for the program and returns the current value that is received by the transmitter. The current value of the Transmitter also changes.

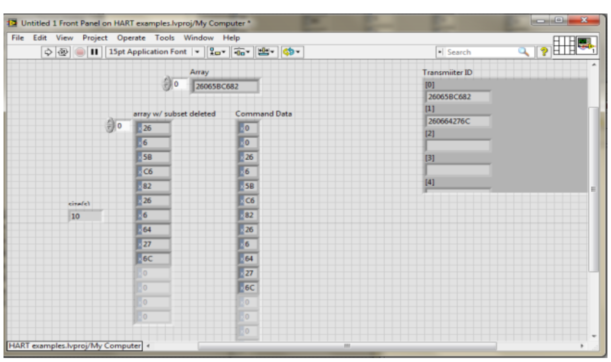

Fig 4.5 List of Transmitters

The total number of Transmitters connected is found is found by the code values.

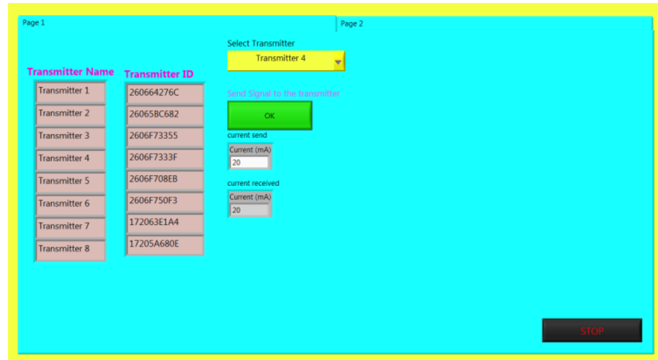

Fig 4.6 Template 1

The Template is created with how many number of transmitters connected and selection of the transmitter to which the current value must be sent. In Fig 4.6 the current value is sent to the Transmitter 4.

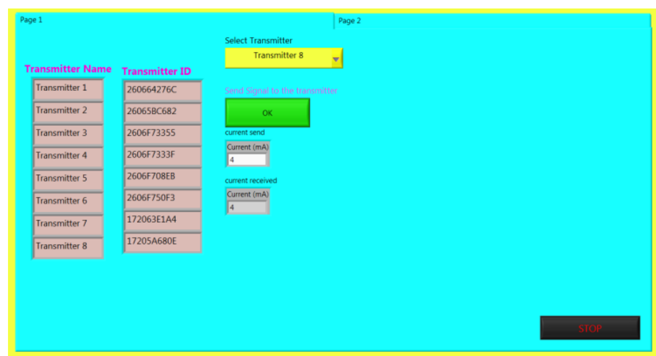

Fig 4.7 Template 2

In Template 2 the current value is sent to Transmitter 8.The Template shows the Transmitter's ID and the channel details from the server so that the server data from the Transmitter and the current value from the HART Communication can be compared.

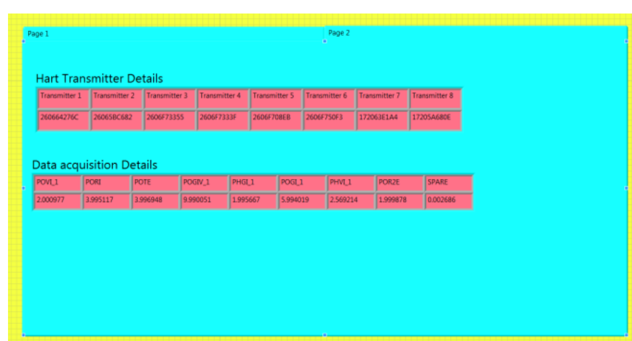

Fig 4.8 Template 3

V. CONCLUSION

The Hart communication and the field devices start to communicate using the 24V power supply. Using Lab view software, the automated performance evaluation is done. The command mode to find the transmitter id and the current (4-20mA) signal of the transmitter is programmed and the output id obtained. Also a program is designed to send a 4 - 20mA signal to the transmitter in case of testing the transmitter. So that the HART device and the field devices start to communicate. First the Transmitter ID for the 8 Transmitters are found. The Data acquisition process is most important because the Transmitter values are send to the nodes for monitoring. The channel name and the channel value to which the Transmitters are connected is displayed. The loop test is done with all the Transmitters connected. A template is created for the loop test done with the 8 Transmitters. By this the cabling used for this process is also reduced. This project proposal leads to an automatic performance evaluation of the 1800 transmitters without any manual interpretation of the humans. Also it reduces the amount of time taken for HART process from 5-7 days to finish within approximately 5 hours. The drawbacks of the previous work such as manual work and human errors also the long processing time is replaced in an effective way. This dramatic change in time reduction helps in easing the work of the employees. By introducing this project method the manual errors and the timing is reduced and the accuracy of the HART communication is increased.

REFERENCES

[1] Yusen Li, Ye Wang, Cong Ma, "Design of Communication System in Intelligent Instrument Based on HART Protocol", Proceedings of 2015 IEEE, International Conference on Mechatronics and Automation August 2-5, Beijing, China.

[2] N. Muthukumaran and R. Ravi, 'Quad Tree Decomposition based Analysis of Compressed Image Data Communication for Lossy and Lossless using WSN', World Academy of Science, Engineering and Technology, Volume. 8, No. 9, pp. 1543-1549, 2014.

[3] Amir Firoozshahi, Hossein Allahyari, Farzad Haghdosti, Intelligent and Innovative Valve Control DCS-based in Large Tank farm Oil Terminal, 20ll 3rd International Conference on Advanced Computer Control.

[4] Fang Jun1, Dai Shuguang, A Double Power Supply Network Design for Muti-Channel Transmitter Based on HART.

[5] N. Muthukumaran, Mrs R.Sonya, Dr. Rajashekhara and V. Chitra, 'Computation of Optimum ATC Using Generator Participation Factor in Deregulated System', International Journal of Advanced Research Trends in Engineering and Technology, Vol. 4, No. 1, pp. 8-11, January 2017.

[6] Gangyi Wang, Qunli Shang, Shan-en Yu, Sheng Yang, Design of PC communication with HART field instrumentation, 2012 International Conference on Computer Science and Electronics Engineering.

[7] N. Muthukumaran and R. Ravi, 'Design and analysis of VLSI based FELICS Algorithm for lossless Image Compression', International Journal of Advanced Research in Technology, Vol. 2, No. 3, pp. 115-119, March 2012.

[8] Pavel V. Nikitin, Senior Member, IEEE, and K. V. Seshagiri Rao, Senior Member, IEEE, Lab VIEW-Based UHF RFID Tag Test and Measurement System. Pavel V. Nikitin, Senior Member, IEEE, and K. V. Seshagiri Rao, Senior Member, IEEE.

[9] P. Venkateswari, E. Jebitha Steffy, Dr. N. Muthukumaran, 'License Plate cognizance by Ocular Character Perception', International Research Journal of Engineering and Technology, Vol. 5, No. 2, pp. 536-542, February 2018.

[10] T. R. Melo, J. J. Silva and J. S. da Rocha Neto, Senior Member, IEEE,Implementation of a Decentralized PID Control System on an Experimental Platform Using Lab VIEW, IEEE Latin America Transactions, VOL. 15, NO. 2, FEB. 2017.