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Hardware In Loop Architecture For Testing Servo Motor Controller Using Iot

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Abstract: Hardware in the loop simulation is a type of control simulation process in which the physical part of the system on which the test is to be performed is connected virtually using its mathematical model and is tested by various test parameters. The plant (physical part) is an actual copy in terms of virtual mathematical model in Hardware in the loop architecture. Hardware in the loop decreases the safety and risk parameters as all the tests are perform virtually which influences various things such as cost, efficiency, and development time of the plant being tested.

This project focuses on the development of Hardware in the loop simulator architecture for Servo Motor. The software used for the development of the project is IoT based cloud that uses graphical programming and virtual user interface. Hardware in the loop system uses real time testing, IoT cloud application provides us various options for inputs and outputs for real time data.

Index Terms - HIL, ECU Testing, IoT, Device under test.

I. INTRODUCTION

Hardware-in-the-loop (HIL) testing is an alternative to standard testing methods for embedded systems, IC based components, controllers etc. In HIL these components are tested using simulation techniques instead of actual physical components. In HIL the component being tested is tricked to work as if it is part of the final assembled product. This allows developers to run through thousands of possible scenarios to test the component without spending the time and cost associated with actual physical testing.

HIL testing uses powerful simulation software running in cloud with special hardware modified to have ports so that the interfaces of the component to be tested. A HIL test software places the component in a simulated version of the machine/device it is a part of and interacts with its real I/O as though the physical machine/device is present. As the software can be updated, changes in the device/machine's electronic architecture and software can be quickly incorporated. This allows a wide breadth of relevant scenarios and expansion of test coverage as needed to comprehensively test without risk to a physical, costly system.

II. SYSTEM DEVELOPMENT

In this project we have developed the test system for servo motor controller. As discus in previous section HIL test system has to be developed along with the product which is to be tested. So that interface for test system is created during design step. In the same way we developed the servo controller and its test system.

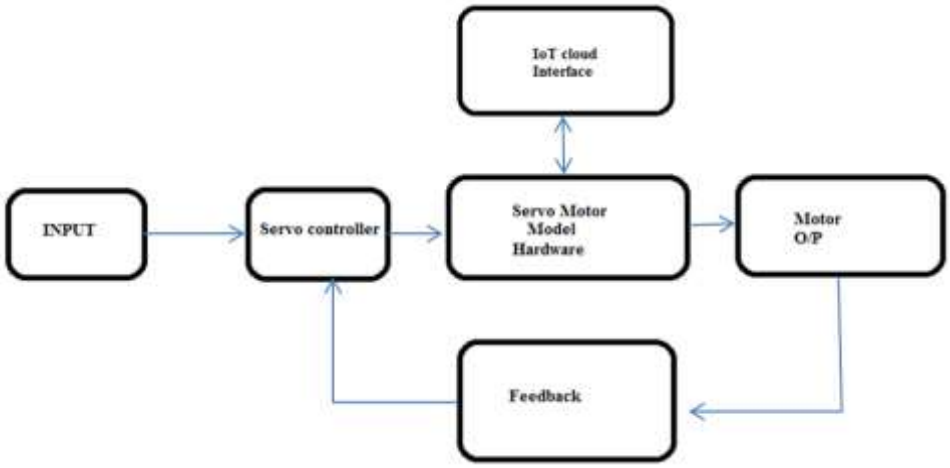

Figure 1 Block diagram of IoT based HIL for testing of Servo controller

2.1 Servo controller

The servo controller is basically microcontroller embedded system built on arduino uno open source board. This servo controller generates the necessary signal to operate servo motor. The interface given to control the motor is as shown in fig. 2. To increment or decrement the angle position of servo motor separate pins are allocated.

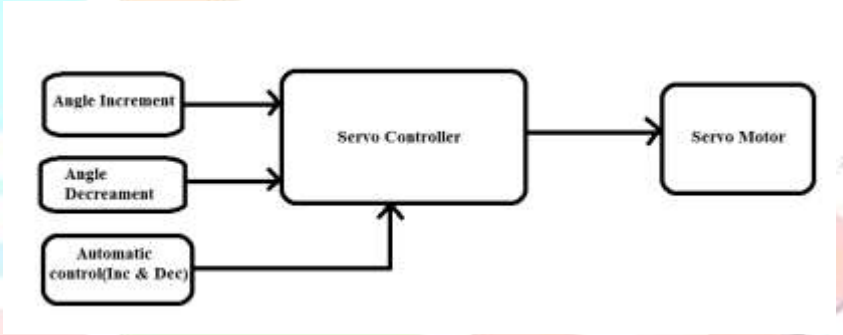

Figure 2 Servo motor controller

The single pin automatic control also presented. The angle can be set to 0 to 180 degree using the interface pin provided. Setting active low on the interface pin will activate the requested function.

2.2 HIL test system

Development of HIL test system was the main aim of the project. It is built in IoT environment comprising of Hardware ESP8266 based NodeMCU and internet cloud. As like real physical control buttons and servo motor simulated in IoT based interface. As shown in the snapshot of user interface of test system the servo angle position increment, decrement buttons are provided. We have to connect the test hardware to servo controller. The servo controller will generate the PWM waveform to control the servo motor. The PWM duty cycle decide whether to move clockwise or anticlockwise with angle position with rest to duty cycle.

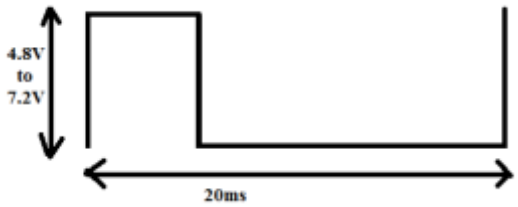

Figure 3 Servo controller output PWM

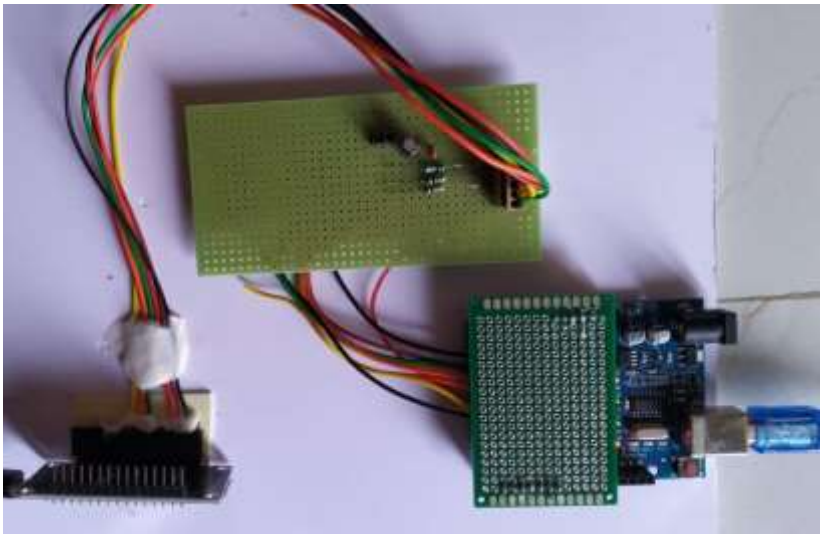

Figure 4 Photograph of servo controller test system

As shown in photograph Fig.4 Ardiuno uno board is used for controlling servo motor. Instead of servo motor we can connect the HIL simulator as shown NodeMCU connected to Six pin relimate connecter. For servo motor 3 Pin burg connecter is provided and interfacing control can be done using pins present in six pin relimate connector.

III. RESULT

The HIL test set up done to simulate the servo motor for testing embedded servo controller. Instead of physical button we used IoT interface for operating servo controller.

Figure 5 Snapshot of IoT interface

There are three buttons angle position increment, decrement and auto testing. By pressing INC button HIL simulator send command to servo controller and monitor the servo controller output and display in the form of angle potion in gauge. The change in angle with time also plotted with time as shown in graph fig. 6. It also shows the test result angle increment result OK.

Figure 6 HIL simulator result

We have verified the simulator working by connecting actual physical servo motor. The result shown in simulator and real

physical servo motor position are matching.

IV. Conclusion

The IoT based HIL simulator designed and developed here works as per the requirement and can be modified easily just by software. Hence it reduces the cost of actual physical set up. It also reduces the risk associated with failure due to faulty designed embedded product as the result is in software simulation not in actual physical device. Testing can be done in many simulated variation just by modifying software.

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