

Title:

Virtual Robot Control by LabView® SolidWorks® and Data Acquisition Systems Connection

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Introduction:

The research describes the use of a virtual environment using LabView® and Solidworks® to simulate the behavior of a robot, which is controlled by LabView® software, Data Acquisition Systems (DAQ), Field Programmable Gate Array (FPGA) of National Instruments, microcontrollers and a Wii® controller (Wiimote), the latter connected by Bluetooth. The accelerometers in the controlling hardware were used to move the virtual joints of the modeled robot in SolidWorks®. This design has been developed to be used within the facilities of an Automotive Engineering Research Center during crash safety tests. The purpose of this system was to accomplish improvements during the tests such as a reduction in the setup and acquisition time to locate targets for impact tests. As a consequence, a better understanding of the manipulation of the robot was gained. This resulted in an increase in the confidence interval and improved the accuracy of the test results that can be used for a better assessment of the safety test of motor vehicles. This work has been developed for implementation in the Safety Vehicular Area of an Automotive Company in Mexico. This specific area has the responsibility to develop solutions, engineering designs, equipment tools and tooling to meet the requirements of the necessary standards. Currently, the Safety Laboratory has specialized equipment to perform the tests on vehicles under FMVSS regulation.

Main Idea:

The FMVSS (Federal Motor Safety Standard) is a requirement of the U. S. Government Agency, established in rules No. 201 and 226 [3]. The objective of these standards is to establish protection requirements against impacts that could happen in the head of the vehicle occupants and the ejection mitigation systems required to reduce the likelihood of complete and partial ejections of vehicle occupants through side windows during rollovers or side impact events.

Standard No. 201 states that a mechanical or anthropomorphic representation of a human head of 5 kg should be fired to impact at a speed of 16 km/h and/or 24 km/h within the interior of the vehicle, in points previously established by the rule.

The procedure for impact testing inside the vehicle which the engineers of this automotive company have to perform is described as follows:

1. The points to impact are specified in the FMVSS regulation
2. With the help of a Robot, the points previously set inside the vehicle are located
3. With the setup of the targets and with the help of an electrically driven gripper placed in the gripper of the robot, the dummy (human head) is released to the objective and the relevant data is analyzed to predict the damage suffered by a person

From the steps listed above, step No. 2 has several issues worthwhile to highlight. One of them being the difficulty to reach the impact point previously located due to the size of the robot which makes it difficult to maneuver inside the passenger compartment of a vehicle. Another issue is that the vehicle structure can be hit and damaged while the robot is being handled. This may represent an increase in costs and delays for the automotive company.

In order to solve the aforementioned problem and reduce the time and cost, it is proposed to simulate the behavior of a robot, linking SolidWorks® and LabView®, and make the handling control with a Wiimote, to take advantage of the accelerometers whose interface facilitates the operation without using the “Teach Pendant” which can make difficult the maneuverability of the robot. The simulation of this environment will provide enough information to assess whether it is feasible handling in the real environment or not.

The virtual prototype can be accomplished as depicted in the flow diagram below:

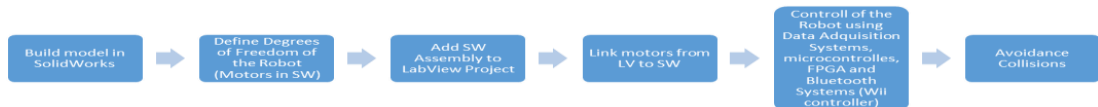


Fig. 1: Virtual prototyping flowchart.

Virtual engines will be placed in each degree of freedom of the CAD model robot in SolidWorks®. Once this has been done, the configuration of this model is done in LabView®, adding the assembly and setting engines to the project. The programming of the LabView® interface uses pre-configured engines, and it will allow the user to control the robot's joints, this can be seen in Figure 2.

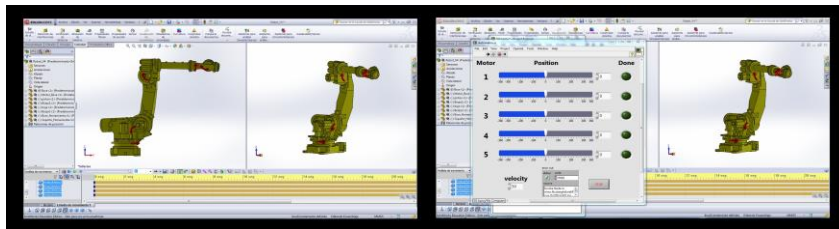


Fig. 2: Virtual Engines in SolidWorks® and LabView® Interface.

As mentioned above, it is possible to control the virtual robot by data acquisition systems of National Instruments (DAQ), FPGAs, Microcontrollers and Bluetooth systems. In order to drive the robot, in an easy and simple way, it is proposed to control by a Wii® controller, which has accelerometers and the connection to the computer, is by a Bluetooth system. The Wii® controller has three main movements (Roll - Pitch - Yaw), which are provided by accelerometers and through programming in LabView® the control of the virtual robot will be granted, in the next figure it can be observed the connection with a DAQ, a microcontroller and the Wii® connection.

Conclusion:

Manipulation of a virtual robot has been accomplished through a Wiimote. One of the main contributions of this research project has been the use of LabView® and SolidWorks® software to create a virtual environment that can be used to assess the feasibility of implementation of the Wiimote in real environments. The use of these remote controllers has resulted in a better robot control that could reduce significantly the setup time in the safety test crash for FMVSS201.

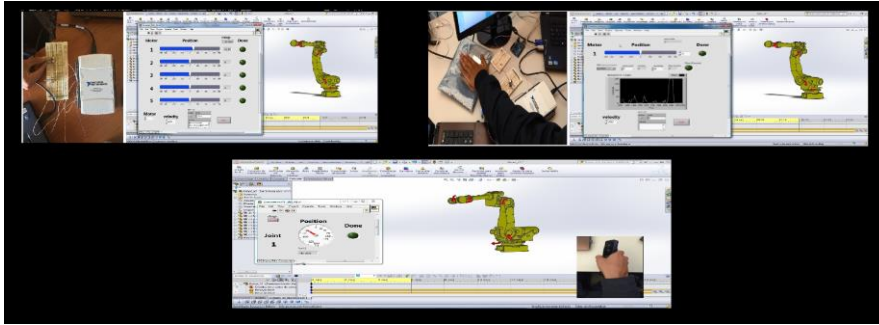


Fig. 3: Control of the virtual Robot with DAQ, microcontroller and Wii® controller.

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