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Design and Implementation of Car Door Latch Testing Machine

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Abstract: ***In this project, we proposed design and implementation of car door latch testing machine. Nowadays cars are a very important part of this modern world because they give luxury and comfort. Even though they are comfortable, some problems always keep arising on the safety side. After a lot of research they rectified certain problems using air bags, auto parking, turbo charger ... etc.***
Likewise "car door latch" is also plays a major role in safety side in automobiles now we are going to discuss about one such problem that arises on the safety side. An unexpected accident occurs when people smash their fingers in between the car doors. Due to this kind of accident around 120,000 people are injured every year. But this was not taken as a very major safety concern for the customer. To avoid this kind accident due to car doors that we make sure of testing of car door latch using latch testing machine by analysing sealing factor, release travel, full release travel, latch opening current, release effort and testing position of the screw by using proximity sensor and to check the presence of the latch cover by using non-contact sensor (photo electric sensor). The working process of the "CAR DOOR LATCH TESTING MACHINE" is, when car door latch is placed in clamp cylinder that fix work piece in place. Then using servo motor actuator, the cylinder is moved forward to lock the latch and load cell is used to measure the sealing factor of car seal (rubber type) when the cylinder is moved in reverse direction. Release travel is measured using LVDT.
Keywords: PLC, Mitsubishi Controller, HMI Device, Reed switch, Proximity sensor, LVDT, 8-Channel relay, Load cell, SMPS Power supply.

I. INTRODUCTION

Cars are a very important part of this modern world because they give luxury and comfort. Even though they are comfortable, some problems always keep arising on the safety side. After a lot of research they rectified certain problems using air bags, auto parking, turbo charger ... etc. Likewise "car door latch" is also plays a major role in safety side in automobiles now we are going to discuss about one such problem that arises on the safety side. To avoid this kind of accident due to car doors that we make sure of testing of car door latches. Throughout the history of the automobile, and during the past four decades in particular, the door latching systems employed by the various original equipment manufacturers have continually and considerably evolved. This project explains about a car door latch testing machine which is used to test endurance and performance quality of a vehicle door latch. The mechanical parts of the car door latch testing machine comprise a marking machine, a lock cylinder, LVDT, a servo motor actuator, load cell, a clamp cylinder. The technical proposal helps in realizing the endurance test and performance quality of vehicle car door latch by high-precision components in combination with programmable control of a PLC controller. This project has simple operation, time saving property, low labour intensity, good versatility and high economic benefit and the test conditions can be set as per requirement and the obtained test data are accurate and truly reflect the endurance test and performance quality of the car door latch in service use.

II. EXISTING SYSTEM

This System specifies the performance requirements and test methods for door locks and door retention components of vehicles. The mechanism locking the door of the vehicle, including latch, internal and external operation and latching mechanism [1]. Component that permanently connect the doors to the body of the vehicle, which also includes the hinges of the hinged door, the guide rails or other support components of the sliding door. The component fixed in the door of the vehicle, and attached with the striker on the doorpost to keep the door locked. Here the performance requirements are found and compared with reference values. Full latching is the engagement position of the latch and striker when the door of the vehicle is completely closed. Likewise secondary latching is also the engagement position of the latch and striker when the door of the vehicle is not completely closed.

Test method done by clamping fixture because the test shall be rigid enough to prevent the door locks or door hinges from sustaining extra local pressure during the test. The component and the clamping fixture shall be firmly connected to validate the test results. The test piece shall be connected to the clamping fixture in the same or equivalent way as in normal production or on the vehicle. The test system shall guarantee the accuracy of loads provided during the entire test. Loads applied during the entire test shall be recorded continuously, excluding the weight (in Newton) on the door lock when loads are applied longitudinally. The tension tester shall apply tension loads not faster than 5 mm/min until the required test load is reached. Finally the validated test piece is dispatched for implementation in car door and then the entire process will continue with a new set of test pieces during every test.

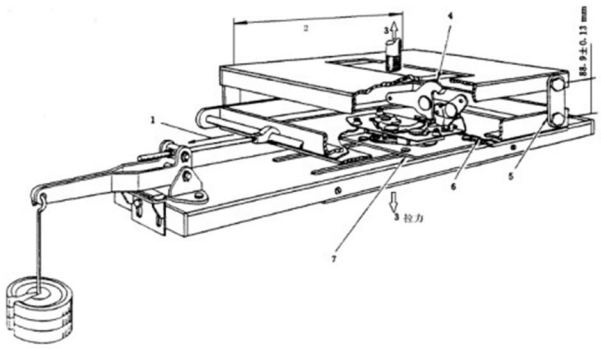

Fig. no: 1 Old model of Car Door Latch testing equipment.

III. PROPOSED SYSTEM

In normal days the car door latch are operated manually the door latch testing machine is also controlled 0ojmanually, it may causes some defects[3] also it may take time for quality check so that we designed a testing machine through programming using PLC and HMI as output interface[2]. The block diagram of car door testing machine is shown in Fig. 2. It is able to test a latch as soon as possible and the process of door latch testing machine are now explained below. We are attaching a door latch in pneumatic clamp cylinder along with cable connected for motor supply and then we check that the latch are placed correctly by using proximity sensor then we are looking the latch with lock cylinder using servo motor actuator towards forward direction then we drag the lock cylinder in reverse direction so that we can measure value[7] in load cell which helps in achieving sealing factor, if the latch is in lock condition the latch is taken as working normal condition else marked as scarp, this involves the manual mode lock and unlocking system[4]. Then automatic process is verified by once again locking the latch with lock cylinder and unlocking the latch by using a power supply supplied to a $4V_{DC}$ motor present inside the car door latch and connected motor should unlock, if it works then the latch is said to be in perfect condition and meanwhile the readings are recorded in LVDT and secondary load cell [8]. The final step involves marking the latch with serial number using marking machine for further reference.

These entire process works based on sequential procedure defined in simulation which is performed on GX Works 3 and GX Developer. Then the tested piece is removed and another piece is placed and the entire procedure will repeat.

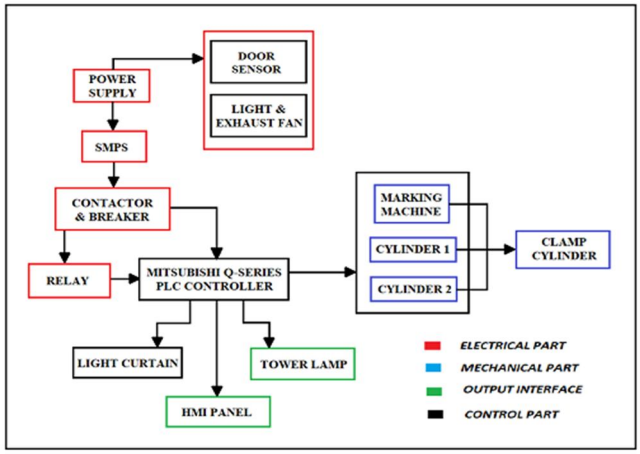

Fig. no: 2.1 Block Diagram of Car Door Latch Testing Machine.

A. PLC Controller

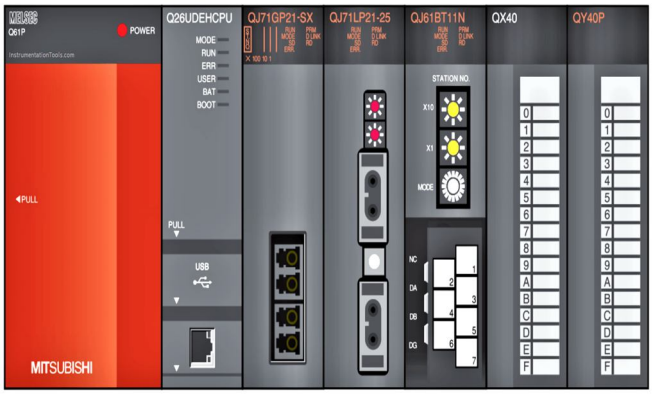

Fig. no: 2.2 Mitsubishi Q-SERIES PLC Controller.

Because of its powerful performance and nano speed technology, we design and implement the project as per the requirements.

Here the entire process is actually controlled in sequential manner by fetching the instructions from SD card and executes the inputs signals by processing, manipulating and computing them to control the output mechanical devices.

B. Load Cell

A load cell acts as a force transducer, which converts load, strain or force acting on it into electronic signal.

Here we measure the load applied on latch during testing of locking and unlocking where the sealing factor is obtained.

Fig. no: 2.3 Force male thread pancake load cell.

C. LVDT

Fig. no: 2.4 LVDT.

A Linear Variable Differential Transformer which commonly acts as electro mechanical transducer that converts linear motion of an object to which it is connected or coupled mechanically into a corresponding electrical signal. Here we used to obtain the values of release travel and full release travel of car door latch.

D. MCB & Contactor

Fig. no: 2.5 MCB and Contactor.

Miniature Circuit Breaker is used to protect the installation or appliances against short circuit faults and sustain over-loading. Hence it plays a major role in a protecting the entire setup.
Contactor is an electromechanical switch whose function is to make or break the connection between the power supply and the load.

E. SMPS Power Supply

Fig. no: 2.6 SMPS Power Supply.

Switched Mode Power Supply is an electronic device which supply or transfer from a source usually an AC source to a DC devices. Here we used to convert 220 v AC supply into 24 V DC supply.

F. Servo Motor Actuator

Fig. no: 2.7 Servo Motor Actuator.

Servo Motor Actuator is a linear or rotary actuator that allows for precise control of linear or angular position, velocity and acceleration. Here we used to move the lock cylinder in forward and reverse movement during lock and unlock testing process.

G. Proximity Sensor

Proximity sensor is used to detect the nearby objects without coming into physical contact.

Fig. no: 2.8 Proximity Sensor.

Here we used M8 proximity sensor to detect the presence of screw position behind the car door latch.

H. HMI Box

HMIs allow operators to start and stop cycles, adjust set points, and perform other functions required to adjust and interact with a control process.

Because the HMI is software based, they replace physical wires and controls with software parameters, allowing them to be adapted and adjusted very easily.

I. Light Curtain

The basic type includes a muting function which temporarily disables the safety light curtain when a work piece passes through.
In the event of any trouble occurring, the error can be instantly recognized from the pattern of the LED indicators, allowing for a fast solution.

IV. RESULT AND OUTPUT

The output model of car door latch testing machine is shown in Fig. 3. The result and output is obtained based on sequential execution of the program and stored in database which can be accessed with reference to serial number printed on car door latch.

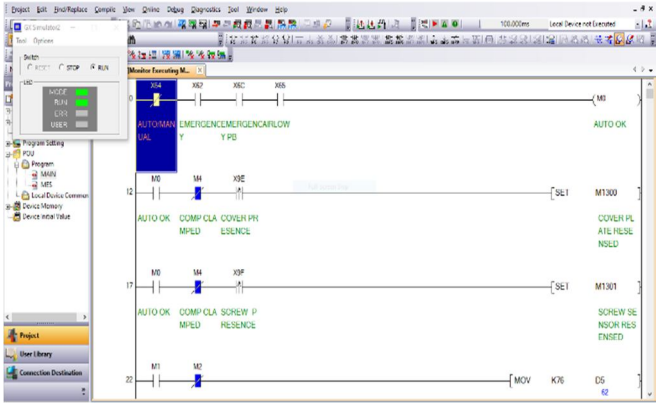

Fig. no: 3 output and Result by GX Works 3.

V. CONCLUSION

Therefore, we were tested the car door latch in both manual and auto power operation using PLC controller, and the result are recorded which can be accessed for future reference using serial number printed on car door latch. We are successfully achieved in testing the auto and manual operation of car door latch where the results can be viewed in HMI Panel during completion of the process. Thus we successfully achieved our main scope of the project that is we provided a quick process and analyzed the quality check for car door latch.

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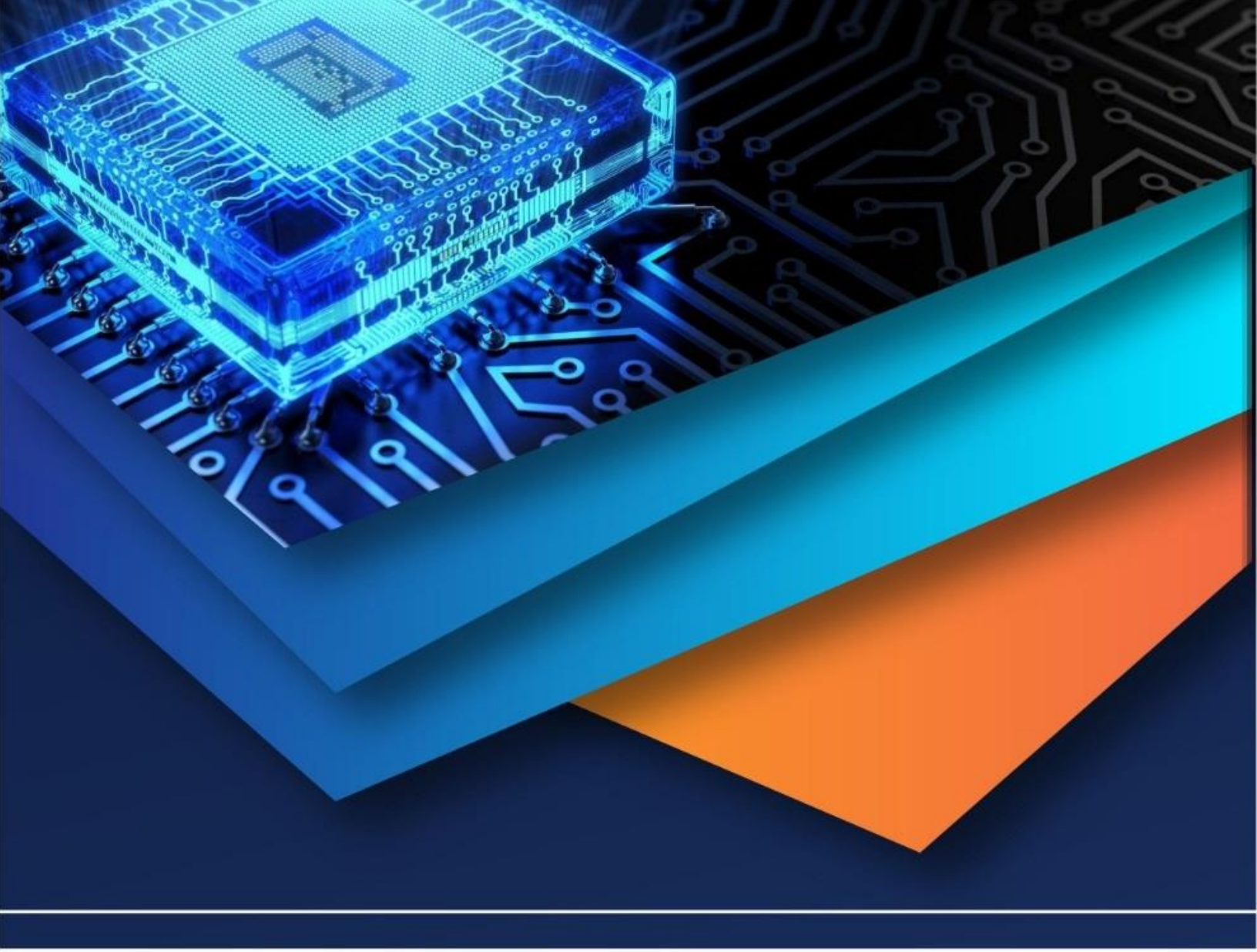

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