International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 15 (2018) pp. 12099-12103

Automated Dry Test on Fuel Petcock

Mohammed Najith.S [1], Parthiban. P [2], Mohan Gandhi, Muthiah C.T [3]

[1,2,3] Rajalakshmi Engineering College, Rajalakshmi Nagar, Thandalam, Chennai, Tamil Nadu 602105, India.

Abstract

Petcock is used in various devices and automobiles to transfer fuel from the tank to the carburator. If there is crack on the petcock it will lead to fuel leakage. In order to prevent this wet test is done on the petcock, by placing the petcock on the water and turning the position of the handle to ON, OFF and reserve and look for bubble formation. This is time consuming so an automated dry test is developed to test the petcock. In our concept the petcock is tested using a automated dry test and the use of blower in the wet method can be removed and the accuracy of the test can be increased. The materials used in this method is pneumatic double acting cylinder and pressure sensor.

Keywords: Automation Process, Petcock testing, Test petcock with air

INTRODUCTION

Petcock is a device which is widely used in automobile industries and various other industries that includes even in marine engines.to transfer fuel from the fuel tank to the carburator. Since petcock is formed by the casting process, it might have crack after the casting process, which can lead to fuel leakage if not noticed. In order to prevent this, the petcock is tested before it is sent to the industry for assembly. Wet test on fuel petcock is a technology which is used to test the cracks in petcock by using the water. In industries the wet test method is being used, can be replaced by dry test which uses air to test, this dry test method is semi automated, hence the accuracy will be high and the operator does not require any skill to operate it.

In the wet test method, the petcock is placed in the water and is rotated manually to all the three position ON, OFF and reserve by the operator and then it is seen for any bubbles to be formed or not. If there is any bubble formation in any of the positions then the petcock is found to have crack. The bubbles size may vary based on the size of the hole. If the hole size is small then the bubble formed will be less and if the hole formed is large then the bubble formed with be bigger. If the bubble size were to be small then sometime the operator may not notice the bubble formation.

Automation is a technology which is being implemented in most of the industries such as Automobile Industries, Manufacturing Industries, etc. Automation or automatic control, is the use of various control system for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Some processes have been completely automated.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices computes, and other such types of systems. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. The benefit of automation is very high which includes labor savings, savings in electricity cost savings in material costs, and improvements to quality, accuracy and precision.

Today extensive automation is practiced in practically every type of manufacturing and assembly process. Some of the larger processes include electrical power generation, oil refining, chemicals, steel mills, plastics, cement plants, fertilizer plants, pulp and paper mills, automobile and truck assembly, aircraft production, glass manufacturing, natural gas separation plants, food and beverage processing, canning and bottling and manufacture of various kinds of parts. Robots are especially useful in hazardous applications like automobile spray painting which handed manually can lead to a lot of wastage and improper painting. Robots are also used to assemble electronic circuit boards. Automotive welding is done with robots and automatic welders are used in applications like pipelines.

Lights out manufacturing is when a production system is 100% or near to 100% automated (not hiring any workers). In order to eliminate the need for labor costs altogether. Lights Out Manufacturing grew in popularity in the U.S. when General Motors in 1982 implemented humans “hands-off” manufacturing in order to “replace risk-averse bureaucracy with automation and robots”. However, the factory never reached full “lights out” status.

The expansion of Lights Out Manufacturing has peaked interest in recent times due to the successful and well-known Japanese Robotics company “FANUC” (factory automation, numerical control). Another successful autonomous operation factory would be beer factory in Mexico that can “bottle or can, package and send to the market” with only six humans supervising.

This system can also be an opening for lights out manufacturing which is seen in most of the industries now a days as the accuracy can be made high and the products developed can be of higher quality.

Even if the wet test system were to be automated for more accuracy then the camera must be placed and image processing must be done if there is any presence of hole which is cost higher. After the petcock is tested the petcock is placed in the blower to remove the water in it, which is an additional process.

In dry test, the petcock is tested using air as a tool and the method is automated so that the accuracy can be increased. The operator can test the peacock at ease without any experience required. The stage of blower can be removed as there is no use of water in this method. The cost of the automation process is lower when compared to wet test, if it were to be automated.

METHODOLOGY

A. Overview

Air is used as a tool for testing of the petcock. Therefore

In order to control the air flow direction, the directional control valves are used. Two five by two directional control valve (DCV) to control the cylinder and one three by two directional control valve to control the air flow through the cylinder. The arduino is programmed to control the directional control valve, but the directional control valves requires 24 volt while the arduino can give only 5V as output, so relay circuits are used to trigger the directional control valve when arduino sends a signal for the dcv to actuate. Two double acting cylinders are used to seal the holes of the petcock.

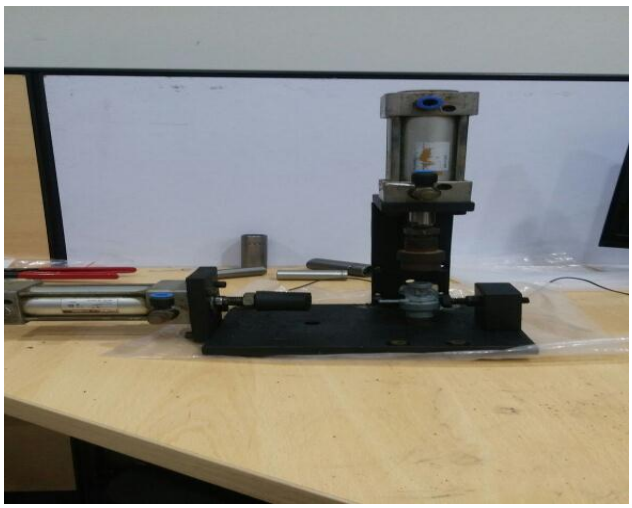

Figure 1. The mounted piston setup for sealing holes

The signal from the pressure sensor is 24volt while the arduino requires only 5V supply so another relay circuit is used to convert the 24V supply to 5V supply and is fed to the arduino. The servomotor is used to turn the handle of the petcock to all the three positions.

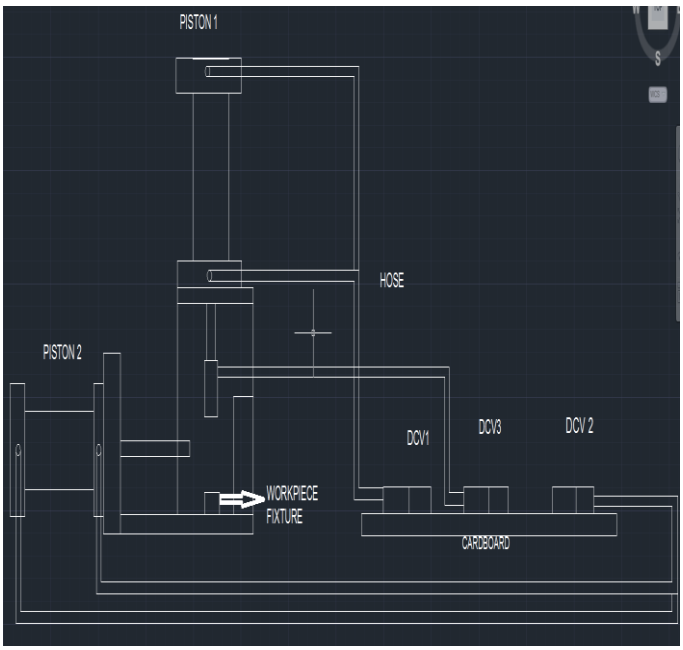

Figure 2. Rough 2-D model

B. Working

The petcock has two holes. One hole is connected to the fuel tank and the other hole is connected to the carburetor of the automobile vehicle. The petcock is placed in a fixture and the petcock is sealed on one end using a pneumatic double acting cylinder. The other end the petcock is also sealed using a double acting cylinder but a port is made on the piston so that the air can be allowed to pass through the compressor. The double acting cylinders are controlled using the five by two directional control valve. The pressure sensor is placed in between the chuck valve and the double acing cylinder through which the air passes.

Since the petcock is sealed the pressure keeps increasing as the air is kept passing into the petcock. The pressure sensor waits till the pressure reaches a certain stage. When a required pressure is reached the pressure sensor sends a feedback signal to the relay which in turn triggers the relay and sends signal to the Arduino and the arduino is programmed in such a way that it sends signal to the three by two directional control valve that controls the air flow of the compressor. Now the chuck valve does not allow reverse flow of air and so the pressure is maintained from chuck valve to the petcock. The sensor keeps sending the feedback signal until the pressure gets down. When the pressure goes down below the stated pressure point then the pressure sensor stops sending signal.

After this the pressure sensor reads if there is any pressure drop in the OFF position for 15 seconds, in which for every 3 seconds it checks for pressure drop. Petcock handle is then turned using the servomotor to ON position if there is no pressure drop and then the sensor again checks for the pressure drop in the similar way as it was done for the OFF

position. If there is no pressure drop reading that is noticed then the pressure sensor keeps sending the feedback signal and so the servomotor turns for the reserve position. Then the pressure sensor is again checked. If there is no pressure drop the Green LED is made to glow and if there is pressure drop in any of the positions then the feedback of the pressure sensor is cut off to the arduino and so the Red LED is made to glows.

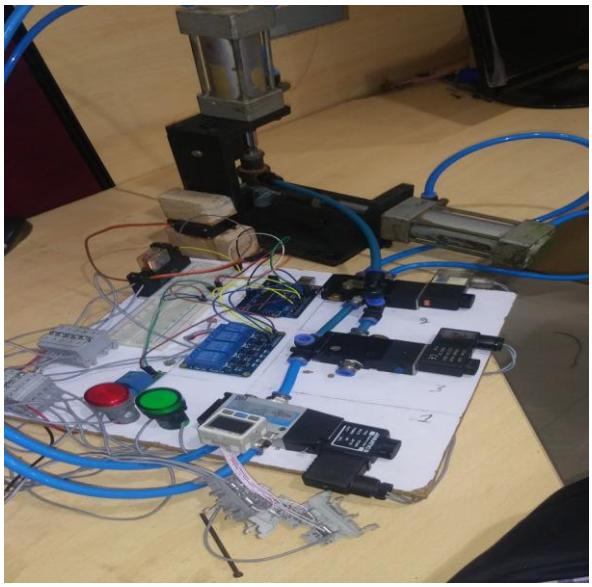

Figure 3. The overall setup

C. Hose Connections

The hose connection for the cylinder to the Directional Control Valve is given so that the piston movement can be controlled for sealing and unsealing the petcock and also the air that is passed through the petcock for testing whether the petcock has a crack or not. This connection will show the way in which the hose are connected. If there is any leakage in the connection of the hose would lead to the error in the detection of the test and so careful connection of hose should be done for an error less output of the test. So hose connections play an important role in test.

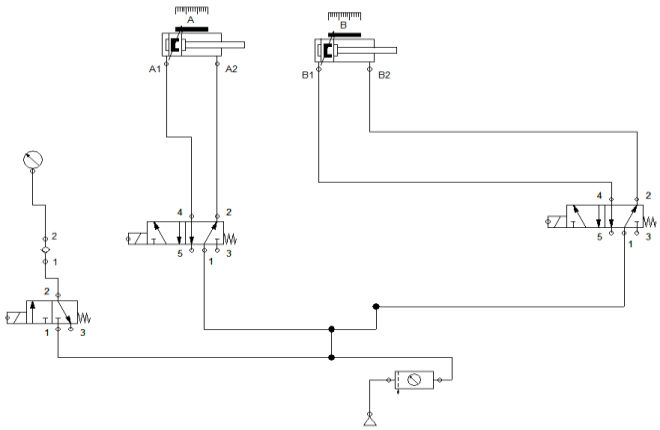

Figure 4. Hose connections through the system

D. Air flow through the system before sensor feedback

The air flows through the system based on the working of the directional control valve.The direction of air flows based on the triggering of the relay circuit which controls the directional control valve. The air flows initially from the compressor to the 2 five by two directional control valve and actuates the pistion. Then the air flows through the three by two directional control valve and the air is fed to the petcock until a pressure is reached. When the pressure which is required is reached then the pressure sensor sends feedback to the arduino. The air after that flows differently, which is the way it flows till the end of the test.

E. Airflow through the system after sensor feedback

After the feedback is given to the arduino then the air is passed to the cylinder continuously but the air to the three by two directional control valve is shut and the air tends to pertain inside the system due to the presence of chuck valve which does not allow the reverse flow of the air. This will help in maintaining the pressure from the chuck valve to the petcock. This air is the one which helps in finding out if the petcock has a crack or not, when the petcock is turned to all the three positions this air tends to leak from the petcock and The flow after the sensor feedback is important. If there is any leakage of air in any part of the system connections, would lead to error detection.

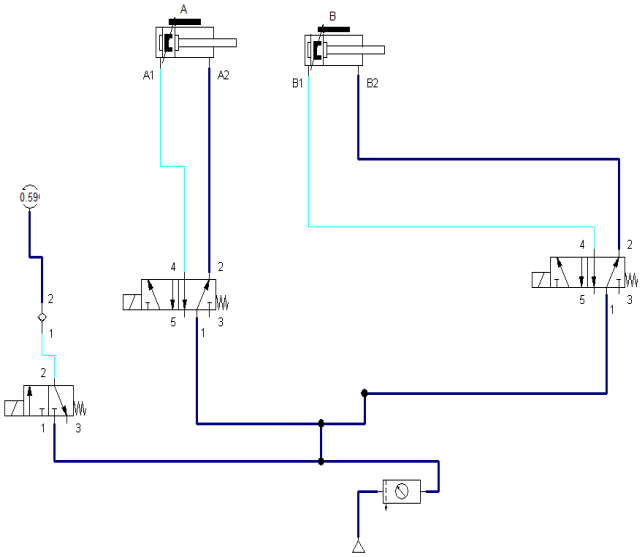

Figure 5. Airflow through the system after feedback

F. Electrical connections

The arduino positive of 5V and the negative GND is connected to the breadboard. The servomotor positive is connected is arduino positive from the bread board and the negative is connected to the negative of the arduino through bread board. The servomotor is connected to the allotted pin in the arduino .The three relay circuits controlling the directional control valve has the same connection. The NO

port is connected to the respective arduino pin that is allotted for the respective directional control valve and the CM is connected to 24V. The pressure sensor is connected to the 24V supply and the feedback from the sensor is also 24V and so another relay circuit is connected and is used to reduce the volt of 24V to 5V and is supplied to the arduino to read the input signal.

RESULT AND DISCUSSION

The petcock if tested by this method could be tested more accurately and effectively. The time comsumption for testing by the old method is based on the experience of the operator and if the operator had more experience, the time taken per piece would be low and if the operator has less experience then the time taken will be higher. Here the operation is easy and since the method is automated and so any type of operator could handle it without any experience required.

Since the traditional method uses water, they have to continuously replace old water with new one. In dry test we can overcome this limitation as there is no use of water. There is no special type of air used so there is no need to replace.

This traditional method requires the use of blowers and so the there is additional stage before the packing process. If dry test is used then there is no need for any blowers since it is not dipped inside any water for testing. So a stage can be skipped if dry test is used.

The operator has to turn all the three position to check for bubbles in any of three positions, which will lead to fatigue and their performance can be reduced. Dry test method does not allow operator to experience any kind of fatigue as the process is automated and so the performance of the operator is maintained.

As the system is automated the accuracy of the system is high. If the traditional method were to be automated then, the image processing method should be used to see the formation of bubbles and so the cost of the entire system will become high. In our method even though the system is automated the overall cost foe the automation of the system is low when compared to traditional method.

Since the method is automated and if further developments done on it, could be used as an application for internet of things and can even be used in lights out manufacturing. Thus dry test if used in industry could give a better yield than the wet test that is currently used in the industry.

CONCLUSION

From the result and discussions we could arrive to the conclusion that the dry test has a better advantage over the wet test. It can be used in industry where semi automation is used. As the world is moving faster towards automation and better production, this technology if developed further developed to test more petcock at the same time with the use of two cylinders just to seal the holes of more petcocks. By this way we can increase the production rate. PLC can be used to control in these kind of systems. The production rate can be increased tremendously if this were to be further developed.

This method if further developed could help in lights out manufacturing. If there is robot hand just to place the petcock in the fixture we could see an application of lights out manufacturing in it. This if developed for lights out manufacturing, could also stand as an application for Internet of Things. We could find the number of petcock tested without even use of any labour.

Though dry test has many advantages there are precautions that should be taken. As the system is semi automated placing hands while the test is on progress, could lead to some accidents. But if used in industry could lead to a better output with high accuracy.

As all the systems are getting automated slowly. This could be helful in being one of a system which can be added in the automation sector in the industry where the whole process is done manually. This is cheap when compared to the present method and so it is easily affordable. The industries could employ this method to get a effective output while testing a petcock.

ACKNOWLEDGMENT

The author would like to thank Gokul and Abijith for their suggestion. Financial support from Rajalakshmi Engineering College Machine Vision laboratory is acknowledged.

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