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# Replacement of HMI of Brake Bleeding System

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***Abstract:*** **Vehicle technology has increased rapidly in recent years, particularly in relation with braking system and sensing systems. Braking system is necessary in an automobile for stopping the vehicle. Brakes are applied on the wheels to stop or to slow down the vehicle. Bleeding is the process of removal of air from the braking system. Since air is compressible so any presence of air inside brake lining does not allow transmitting brake force to break liners. This report presents Programmable Logic Controller technology which is used for controlling bleeding process of brakes of the three wheelers in Programmable Logic Controller, Human Machine Interface and the mechanical process of online brake bleeding system highlights the problems associated with existing Human Machine Interface and the probable solutions over it.**

***Keywords:*** **HMI (Human Machine Interface) liquid crystal display (LCD), PLC (Programmable Logic Controller).**

## 1. INTRODUCTION

As we know that the brakes are very important in any vehicle. The brake makes a car or any vehicle to stop while its on the move. This very function makes it one of the most important components of a car. We can't think of a vehicle without brake. As the brake plays such an important role in the well being of vehicle its very important for every automobile industry to take care of it.

The master cylinder is considered the heart of your brake system. This is because it is located at the center of the system. It pumps brake fluid to the wheel cylinder or caliper whenever you push down on the brake pedal. The calipers convert the energy of the brake fluid that is pressurized into pressure. This is what makes the Brake rotors operate. But the presence of air in the master cylinder may be very dangerous to the brakes; even the brakes may become totally useless. Because, while the brake fluid is an incompressible liquid, air bubbles are compressible gas and their presence in the brake system greatly reduces the hydraulic pressure that can be developed within the system. Hence bleeding of the brakes is very essential. Brake bleeding is the procedure performed on hydraulic brake systems whereby the brake lines (the pipes and hoses containing the brake fluid) are purged of any air bubbles.

The benefits of using an HMI along with a PLC are substantial. PLCs tend to be complex, with many wires connected to them, making it difficult to find the correct input to manually toggle. With an HMI, the user can toggle PLC‟s through memory, as opposed to having to re-wire. HMIs also provide a real time view of the system, so if recipe memory in the PLC was to max out, the user could easily wipe its contents without having to disconnect the PLC.

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## 2. BRAKE BLEEDING SYSTEM

### 2.1 Brake Bleeding System:

Brake bleeding is the procedure performed on hydraulic brake systems whereby the brake lines (the pipes and hoses containing the brake fluid) are purged of any air bubbles. This is necessary because, while the brake fluid is an incompressible liquid, air bubbles are compressible gas and their presence in the brake system greatly reduces the hydraulic pressure that can be developed within the system. The same methods used for bleeding are also used for purging, where the old fluid is replaced with new fluid, which is necessary maintenance.

**Functions of Vehicle Braking:**

There are two main functions of brakes:

1. To slow down or stop the vehicle in the shortest possible time at the time of need.

2. To control the speed of vehicle at turns and also at the time of driving down on a hill slope.

#### *2.1.1 Principle of Vehicle Braking:*

Braking of a vehicle depends upon the static function that acts between tyres and road surface. Brakes work on the following principle to stop the vehicle:

"The kinetic energy due to motion of the vehicle is dissipated in the form of heat energy due to friction between moving parts (wheel or wheel drum) and stationary parts of vehicle (brake shoes)". The heat energy so generated due to application of brakes is dissipated into air. Brakes operate most effectively when they are applied in a manner so that wheels do not lock completely but continue to roll without slipping on the surface of road.

### 2.2 Hydraulic Brakes:

The brakes which are actuated by the hydraulic pressure (pressure of a fluid) are called hydraulic brakes. Hydraulic brakes are commonly used in the automobiles.

#### *2.2.1 Principle:*

Hydraulic brakes work on the principle of Pascal"s law which states that "pressure at a point in a fluid is equal in all directions in space". According to this law when pressure is applied on a fluid it travels equally in all directions so that uniform braking action is applied on all four wheels.

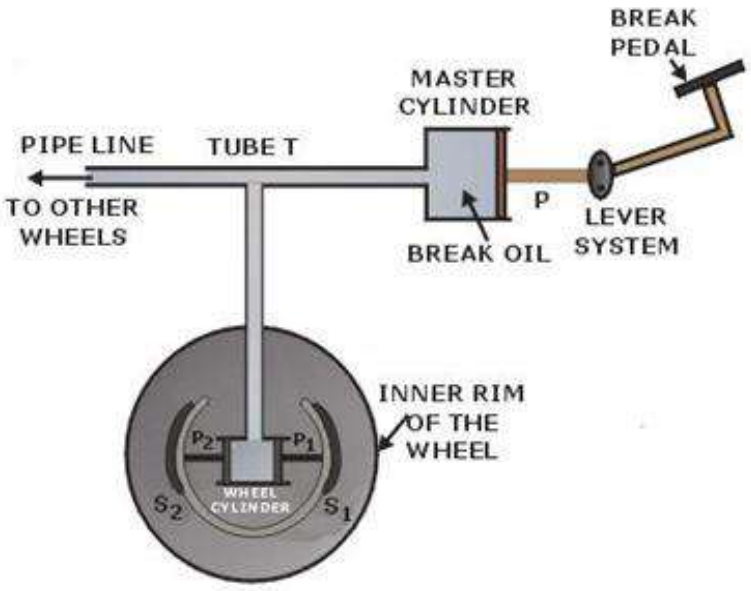


**Fig.2.1: Hydraulic brake system**

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## 3. BLOCK DIAGRAM OF MECHANICAL BRAKE BLEEDING SYSTEM

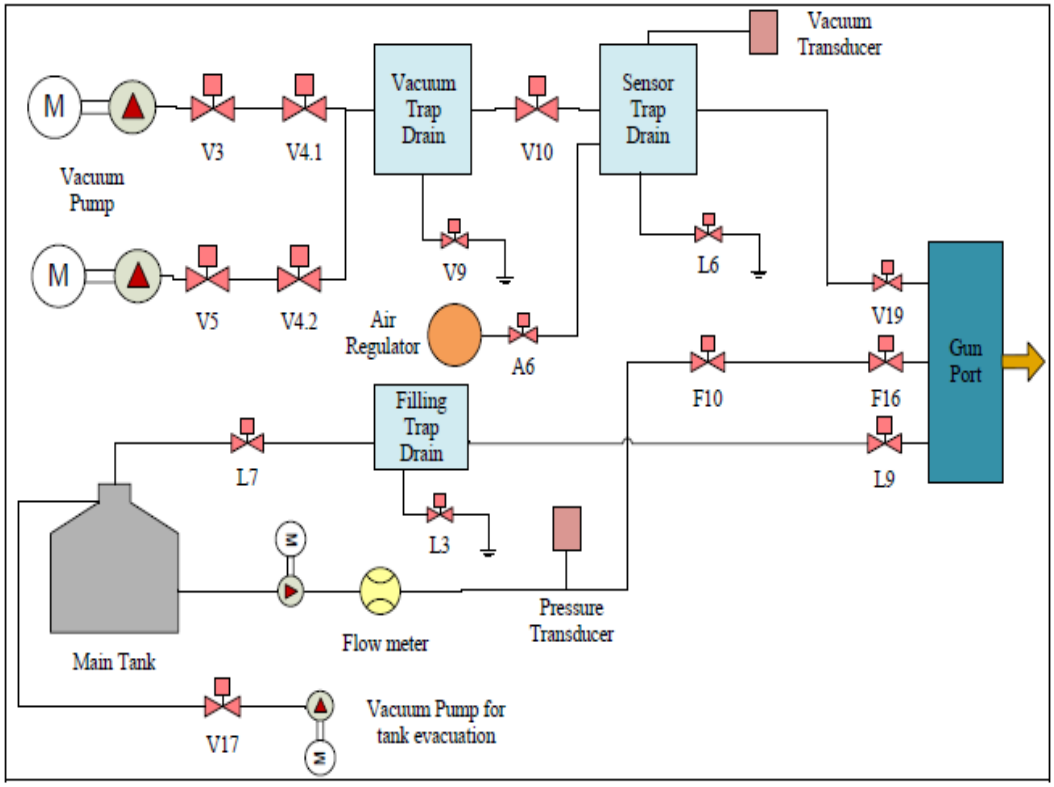


**Fig.3.1:block diagram of mechanical brake bleeding system**

The operation of brake bleeding consists of following cycles:

In the vacuum evacuation and fill system, a clamp is put over a filler tube of the master cylinder reservoir and the whole vehicle braking system is placed into a vacuum.

**1. Evacuation:**

In this process the set point of vacuum is 3mbar. In this process vacuum transducer is used which converts vacuum to the electrical signal (current). This converts 0-250 mbar pressure into 4-20 mA current. If pressure is more than 3 mbar then there may be occurrence of vacuum fault / Major Leakage Fault.

**2. Vacuum & Hold:**

Generated vacuum in Evacuation cycle holds for set time to check any leakages in brake fluid lines. 14

**3. Re-evacuation:**

The process of evacuation is repeated to again evacuate the system after vacuum hold or to overcome the negligible vacuum loss occurred during vacuum hold cycle.

**4. Filling cycle:**

Here the brake fluid filled in system with set pressure and set quantity. For brake bleeding process DOT 3 oil is used as brake fluid. The capacity of oil tank is 250ml. The time required to fill the tank is nearly 30 sec.

**5. Depressurizing cycle:**

During above process the oil pressure get increased up to 3.5 bar. In this cycle the pressure is reduced to the normal pressure. The exceed oil is thrown out through the depressurizing valve by purging the air in filling & leveling lines of filling gun.

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**6. Tank evacuation:**

In this process separate vacuum Pump is used to suck the air. Then the oil is stored in the tank to reutilize.

**7. Cycle complete.**

This indicates the cycle finish to operator for removal of gun.

Whole this process is controlled by using PLC.

**Applications of PLC:**

1) Machine controls

2) Packaging

3) Material handling

4) Similar Sequential task as well as Process control

**Fig.3.2: Example of a PLC application**

5) For timer control in industries

6) Traffic light control

7) Automation of industrial crane machine.

8) Temperature control in industries

**3.3.2 Advantages of PLC:**

1) Troubleshooting is possible easily.

2) Hardware less.

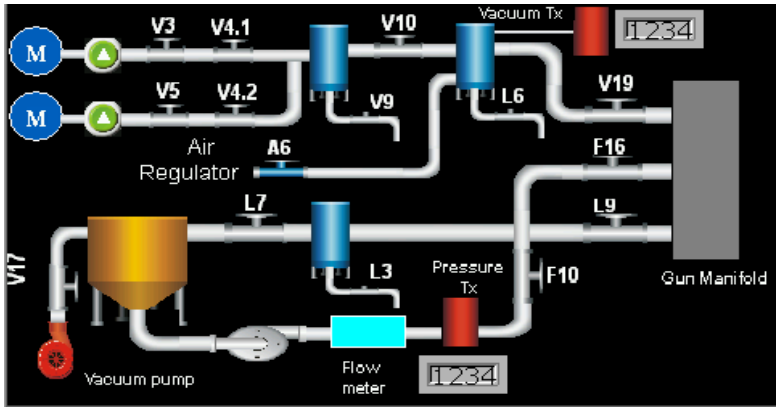


**Fig.3.3: Animated Process Overview HMI screen**

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## 4. ESTIMATION ANALYSIS

Expenditure incurred during project completion consists of expenses for start to complete physical model of the project. Idea or concept of this project has been borne from the requirement of industry. Considering all the requirement of the industry regarding faster and accurate analysis of brake bleeding system we have replaced the existing HMI. The HMI and its components readily available in market were brought and used. PLC, communication protocols, relays and other mechanical and electrical equipments are available in industry.

**Cost analysis of system with Old HMI:**

**Table 4.1: cost analysis**

| Sr. No. | Name | Cost |
|---|---|---|
| 1. | HMI (Black & white OP7) | 80000/- |
| 2. | Software development & editing | 250000/- |
| 3. | Total cost | 330000/- |

**Cost analysis of system with New HMI:**

**Table 4.2: cost analysis**

| Sr. No. | Name | Cost |
|---|---|---|
| 1. | HMI ( Delta ) | 25000/- |
| 2. | Software development & editing | Freely available |
| 3. | Total cost | 25000/- |

## 5. CONCLUSION

The problems associated with old HMI (Siemens OP7) are overcome by replacing that HMI with Delta HMI having colorful display and touch screen facilities.

PLC (Allen Bradley) with the software Microligix500 is used. The PLC gives commands to the HMI (Delta). The HMI represents ongoing operating status of brake bleeding system. For any occurance of fault in brake bleeding system HMI gives indications by generating alarm. Hence Delta HMI improved accuracy, reliability. It reduced time delay. It is economical.

We learnt various software, such as Rs-logix 500, DOP-soft. Also learn to find the tags from the PLC program. We developed HMI screens.

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