 ISSN: 2321-8169
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Raspberry Pi Controlled Single Cylinder Hydraulic

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Abstract—In today's industrial world, industrial automation is to be implemented in many fields in order to reduce the processing time and manpower and also to improve accuracy in the process. This paper deals with implementation of the automation technique which carries out the automation process of hydraulic machine using Raspberry Pi. Now days anautomation of hydraulic machine is very costly, and therefore in many industries semi-automatic hydraulic machines are used. Controlling hydraulic system by using Raspberry Pi could bea cost efficient alternative among various controlling options. By using this automatic control system, a single cylinder hydraulic system is been operated in to and fro direction.

Keywords-*Hydraulic system; Raspberry Pi;*

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I. INTRODUCTION

Automation is one of the development processes in today scenario. It can be done in the industries where more number of labours are involved in the various processes. This causes demand for labours and also some production loss. In order to manage above issues, a control system needs to be easily programmable, flexible, reliable, robust and cost effective.
Most industrial processes require objects or substances to be moved from one location to another, or a force to be applied to hold, shape or compress a product. Such activities are performed by Prime Movers. In many locations enclosed liquid fluids are used to convey energy from one location to another and, consequently, to produce rotary or linear motion or apply a force. Fluid based system using liquids as transmission media are called hydraulic system [1]. Hydraulic system can be controlled by the Raspberry Pi, to fulfil the requirements. A design of single cylinder hydraulic system is been made. The stroke length of the hydraulic cylinder is been restricted by using two proximity sensors which is further connected to Raspberry Pi kit. The to and fro motion of cylinder id thus controlled by using Raspberry Pi.The Raspberry Pi is a wonderful but useful little computer that fits the palm of your hand. It has an ARM processor. Despite of its size it has enough power to run your operating system smoothly, multiple parallel programs, and a lot more. The Raspberry Pi has a SD card slot for mass storage and will attempt to boot off that device from SD card when the board is powered on by 5v micro USB supply [2]

II. HYDRAULIC SYSTEM DESIGN

It works in the following order:

Forward movement of Cylinder→ Backward movement of cylinder. One cycle is completed.
To meet above requirements, the hydraulic system designed is shown in Figure 1.The basic components of the system are pump, strainer, oil reservoir, filter, pressure gauge, pressure relief valve, directional control valve, actuator (Cylinder).All the components are joined together by hoses. The simple hydraulic cylinder can be extended or retracted. Its stroke is set by Proximity sensors, which senses the piston rod at the end of travel.The direction of movement of the cylinder is controlled by the three four-way solenoid valve One-way throttle valve is used in speed adjustment of the return oil throttle.

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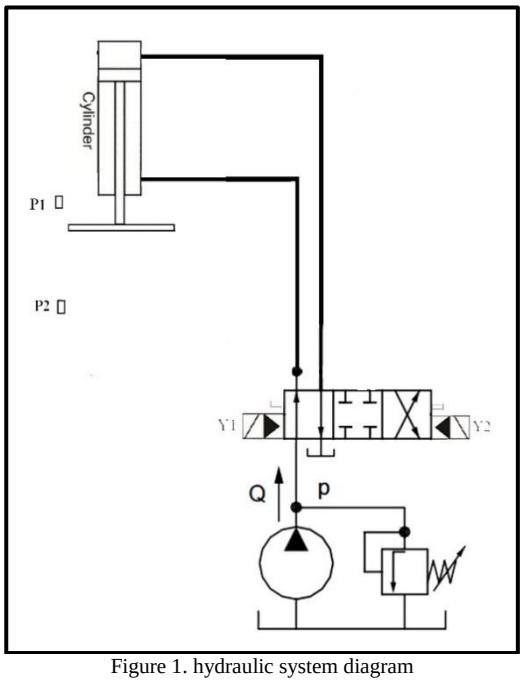

Figure 1. hydraulic system diagram

III. Operation Of Proximity Sensors

The action order of hydraulic system are shown in Table:

TABLE 1. Action sequence table of hydraulic system

Sq. No.	Signal Source	Action	Magnet status	
			Y1	Y2
1	Press Start button	Forward movement		
2	Detect by Proximity sensor P2	Backward movement	+	
3	Detect by Proximity sensor P1	forward movement		+

IV. Raspberry Pi Control System Design

In this paper we have shown you how to create a mechanism to control hydraulic system using your Raspberry Pi, a proximity sensor and two relays. whenever a solenoid movement is detected by the proximity sensor. RPi will work as a controller is will process all the predefined actions that have to be taken after movement detection by sensor

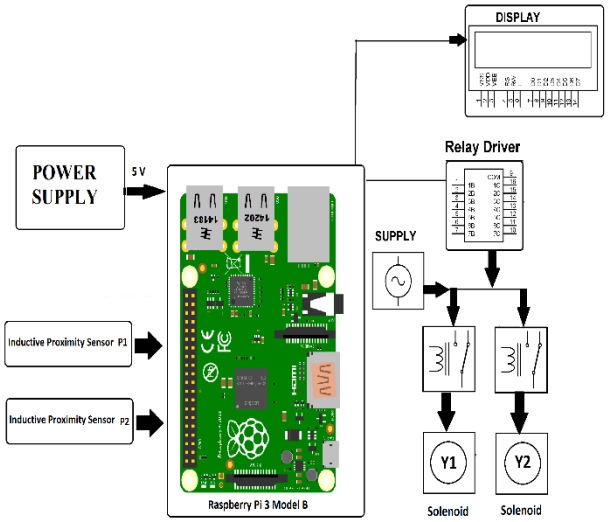

Fig: Connection of Raspberry Pi with Sensors and Relays

A. *Why Raspberry Pi?*

- Processor Used: - Raspberry Pi uses an ARM based processor like ARM Cortex A7 or A53 depending upon the model while the traditional PC/Laptop uses a conventional x86 /x64 Processor from either Intel or AMD. Architecturally speaking the Pi is similar to your smartphone than to your Laptop.

- Memory: Raspberry comes with 1 GB ram for version 3 while most laptops have 2GB /4GB RAM that can be easily expanded to 16GB.Also Laptops can have secondary storage for about 1 TB on most models.
- Peripherals: When you buy a Pi, You get an Single Board computer with a USB ports, A networking port and some other ports. You will have to buy extra keyboard, Monitor, Case etc. to get a usable system. Also a Pi does not have any wireless networking capability like Wi-Fi, Bluetooth etc. when compared to laptop.

- Performance: Latest Raspberry pi 3 model B has 1.2 Ghz processor while most of the laptops and desktop computers have i3 processor which has more computational power over Raspberry Pi.

B. *H/W Specifications*

Raspberry Pi 3 model B has Broadcom BCM2837 System on Chip, 4× ARM Cortex-A53, 1.2GHz CPU, Broadcom Video Core IV GPU, It has 1GB LPDDR2 (900 MHz) main memory for smooth executions of operating system, It comes with 10/100 Ethernet, 2.4GHz 802.11n wireless networking,

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It included Bluetooth 4.1 Classic, for mass storage it must equipped with Micro SD card size may vary from 8 GB to 64 GB, most important part of this Pi kit is its GPIO pins that allows Raspberry Pi to communicate with relays, microcontroller and other electronics peripherals, It also equipped with HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

C. Working Mechanism of Raspberry Pi based Control System.

The RPi (Raspberry Pi) GPIO can be accessed through a python program. We are using GPIO Board numbering means physical number of pin corresponding to the pin's physical location on the RPi's pins header. As sketched in above diagram inductive PIR sensors is connected to GPIO pins 31and 32 and its other leg is connected to ground pin number 9. PIR stands for Passive Infrared. Here we are using 4 channel relays and every relay can separately be switched with the Raspberry Pi because it has 4 GPIO pins so we have connected Input GPIO pins to RPi numbered as 33and 35. In relays voltage needed to operate or switch the relays is 5V, so this can be taken directly from the Raspberry Pi GPIO pins so it is connected to VCC i.e. 5V supply to pin number 2. Likewise its another leg is connected to ground pin number 6 for the proper working of relays. When the inductive PIR motion sensor detects a cylinder movement, it outputs a 5V signal to the Raspberry Pi through its GPIO and we define what the Raspberry Pi should do as it detects movement of an object (cylinder) through the python coding. Here we are making GPIO pin high which is connected to appropriate relay which will start the respective relay. When another inductive PIR sensor detects a cylinder movement it will start respective relays and stops previous relay. This process will be happened in loop forever until machine is on. Sequence of cylinder movement is explained in above table.

D. GPIO Pins of Raspberry Pi 3

These pins are a physical interface between the Pi and the outside world. At the simplest level, we can think of them as switches that you can turn on or off (input) or that the Pi can turn on or off (output). Seventeen of the 26 pins are GPIO pins; the others are power or ground pins. What are they for? What can I do with them?We can program the pins to interact in amazing ways with the real world. Inputs don't have to come from a physical switch; it could be input from a sensor or a signal from another computer or device, for example. The output can also do anything, from Turning on an LED to sending a signal or data to another device. If the Raspberry Pi is on a network, you can control devices that are attached to it from like access to the network, a network capable computing device, and electricity and those devices can send data back. Connectivity and control of physical devices over the internet is a powerful and exciting thing, and the Raspberry Pi is ideal for this.

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