

# **ASSIGNMENT C1**

**Title:** Controlling the operation of the stepper motor using Raspberry Pi /Beagle board circuit.

**Problem Statement:** Write an application using Raspberry-Pi /Beagle board to control the operation of the stepper motor.

## **Objectives:**

- Understanding the connectivity of Raspberry Pi /Beagle board circuit with stepper motor.
- To perform actuation using Raspberry Pi /Beagle.

## **Outcomes:**

The students will be able to

- To interface stepper motor to Raspberry pi/Beagle board.
- To control operation of stepper motor through Raspberry pi/Beagle board.
- Can perform actuation.

## **H/W AND S/W Requirements:**

- Raspberry Pi/Beagle board Development Boards
- PC / Monitor/Keyboard
- Raspbian (OS), Debian LINUX and Python

## Theory:

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word processing, browsing the internet, and playing games. It also plays high definition video.

The Raspberry Pi is open hardware, with the exception of the primary chip on the Raspberry Pi, the Broadcom SoC (System on a Chip), which runs many of the main components of the board-CPU, graphics, memory, the USB controller, etc. Many of the projects made with a Raspberry Pi are open and well-documented as well and are things you can build and modify yourself.

The Raspberry Pi was designed for the Linux operating system, and many Linux distributions now have a version optimized for the Raspberry Pi.

## Stepper Motor:

A stepper motor is an electromechanical device that converts electrical power into mechanical power. It is a brushless, synchronous electric motor that can divide a full rotation into an expansive number of steps. The motor's position can be controlled accurately without any feedback mechanism, as long as the motor is carefully sized to the application. The position is known simply by keeping track of the input step

pulses. Stepper motors are similar to switched reluctance motors.

The stepper motor uses the theory of operation for magnets to make the motor shaft turn a precise distance when a pulse of electricity is provided. The sequence of the applied pulses is directly related to the direction of motor shafts rotation.

### **Types:**

There are three main types of stepper motors, they are:

1. Permanent magnet stepper
2. Hybrid synchronous stepper
3. Variable reluctance stepper

### **Applications:**

1. Industrial Machines - Stepper motors are used in automotive gauges and machine tooling automated production equipment.
2. Security - new surveillance products for the security industry.
3. Medical - Stepper motors are used inside medical scanners, samplers, and also found inside digital dental photography, fluid pumps, respirators and blood analysis machinery.

4. Consumer Electronics - Stepper motors in cameras for automatic digital camera focus and zoom functions.

### **Advantages:**

1. The rotation angle of the motor is proportional to the input pulse.
2. The motor has full torque at standstill.
3. Precise positioning and repeatability of movement since good stepper motors have an accuracy of 3 - 5% of a step and this error is non-cumulative from one step to the next.
4. Excellent response to starting, stopping and reversing.
5. Very reliable since there are no contact brushes in the motor. Therefore, the life of the motor is simply dependent on the life of the bearing.
6. The motors response to digital input pulses provides open-loop control, making the motor simpler and less costly to control.
7. It is possible to achieve very low speed synchronous rotation with a load that is directly coupled to the shaft.
8. A wide range of rotational speeds can be realized as the speed is proportional to the frequency of the input pulses.

### **Actuator:**

An actuator is a mechanism for turning energy into motion. Actuators can be categorized by the energy source they require to generate motion. For example:

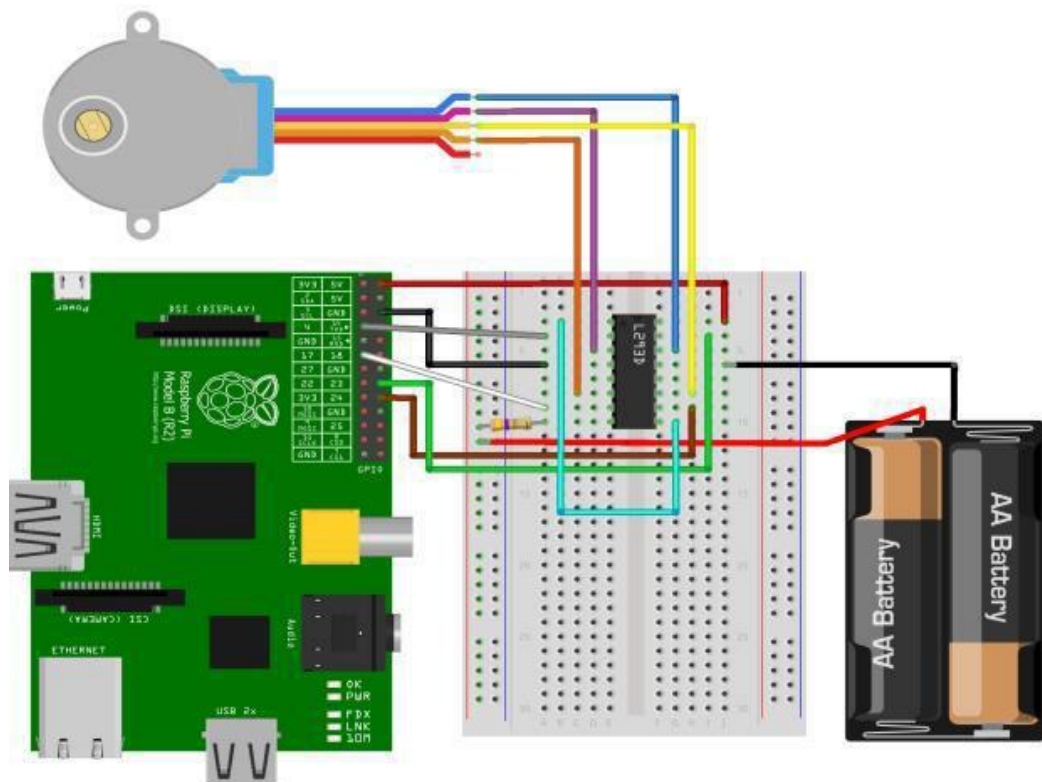
- Pneumatic actuators use compressed air to generate motion.
- Hydraulic actuators use liquid to generate motion.
- Electric actuators use an external power source, such as a battery, to generate motion.
- Thermal actuators use a heat source to generate motion.

## Interfacing with Raspberry Pi:

Raspberry Pi's GPIOs can be used to control stepper motor rotation. We can generate a sequence of control signals on the GPIO pins of Raspberry Pi. The motor connects to the controller board with a pre-supplied connector. The controller board has 4+2 pins that need to be connected to the Pi header (P1).

- 5V (P1-02)
- GND (P1-06)
- Inp1 (P1-11)
- Inp2 (P1-15)
- Inp3 (P1-16)
- Inp4 (P1-18)

### Circuit Diagram:



### **Expected Output:**

The Stepper motor should rotate according to the input provided. The direction of rotation should be controlled via changes in code.

### **Conclusion:**

Thus, we successfully interfaced the stepper motor with raspberry pi and controlled its operations.