

Project report

Ping Pong Ball Levitation

Objective:

- To levitate ping pong object in air at a certain height.
- To construct a MATLAB Simulink program.

Introduction:

In this setup, ping pong object is made stable in air at a certain height provided by user. If the force applied to ball is equal to its mass then it is in equilibrium and will stay stationary in air.

In this project, we use sharp IR sensor a blower fan, a plastic cylinder and an Arduino with Simulink support package.

As the thrust applied by fan is increased, the ball start lifting upward. PID controller is being used to control the height of the ball at desired height.

Components:

- Arduino mega
- Sharp IR sensor 2Y0A21
- Plastic tube
- Blower fan(12V,1.2A)
- Ping pong ball
- H-bridge L293D
- Power supply
- Jumper wires

SHARP IR SENSOR:

Infrared proximity sensor made by Sharp.2Y0A21 has an analog output that varies from 3.1V at 10cm to 0.4V at 80cm. The sensor has a Japanese Solderless Terminal (JST) Connector. We recommend purchasing the related pigtail below or soldering wires directly to the back of the module.

It returns an analog voltage that can be used to determine how close the nearest object is. Comes with 12" long 3-JST interface wire. These sensors are good for short-range detection, has an analog output.

Features:

- Distance measuring range :10-80cm
- Digital output type
- LED pulse cycle duration: 32ms

- Typical response time: 39ms
- Typical start up delay: 44ms
- Average current consumption: 30mA
- Detection area diameter @ 80cm : 12cm
- Supply voltage: 4.5 to 5.5v
- GP2Y0A21YK0F
- made by Sharp

PID:

A Proportional-Integral-Derivative Controller (PID controller or three term controller) is a control loop feedback mechanism widely used in industrial control systems and a variety of other applications requiring continuously modulated control. A PID controller continuously modulated control. A PID controller continuously calculated an error value $e(t)$ as the difference between a desired set point (SP) and a measured process variable (PV) and applies a correction based on proportional, integral and derivative terms (denoted P, I and D respectively) which give the controller its name.

In practical terms it automatically applies accurate and responsive correction to a control function. An everyday example is the cruise control on a road vehicle; where external influences such as gradients would cause speed changes, and the driver has the ability to alter the desired set speed. The PID algorithm restores the actual speed to the desired speed in the optimum way, without delay or overshoot, by controlling the power output of the vehicle's engine.

The first theoretical analysis and practical application was in the field of automatic steering systems for ships, developed from the early 1920s onwards. It was then used for automatic process control in manufacturing industry, where it was widely implemented in pneumatic, and then electronic, controllers. Today there is universal use of the PID concept in applications requiring accurate and optimized automatic control.

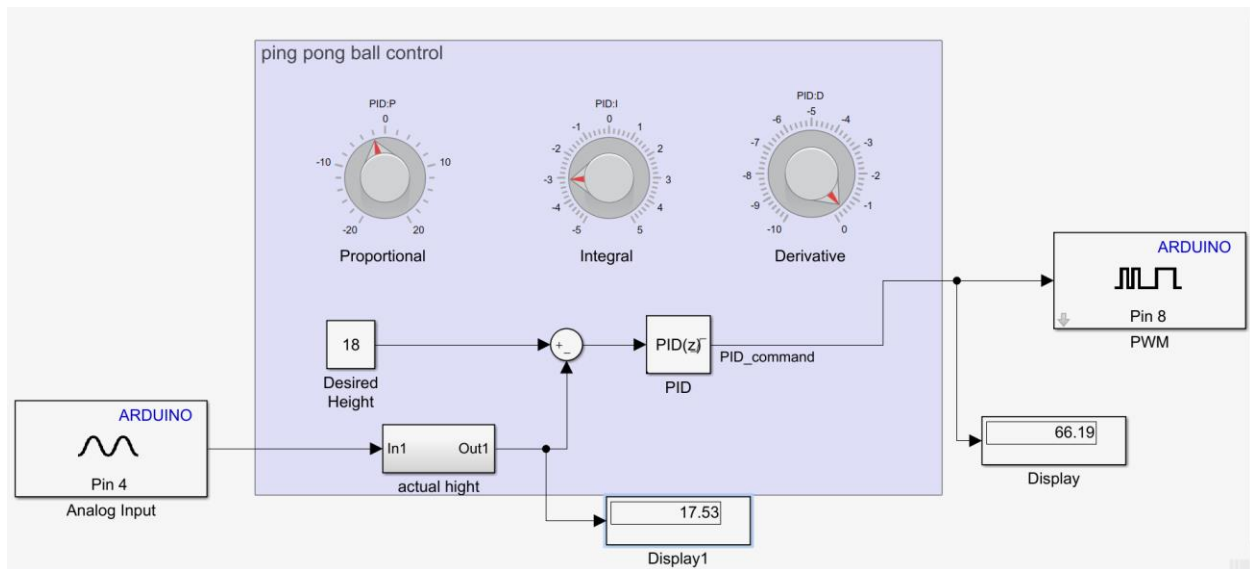
Software:

MATLAB 2017 with Simulink support package

Methodology:

By using MATLAB simlink, and generating PID controller for controlling the height of the ping pong ball on a certain point. For achieving the desired height of the ball first we need to configure to change the IR sensor value into some meaning full value that is obtained by dividing the peak value coming from the sensor and taking 1/parts of the value the by inverting the value and multiplying it by the total height of the pipe. By compensating the P-I-D of the pid controller we will achieve the desired height. PWM is being applied on the pin#8 and analogue value of the IR sensor is being noticed from analogue pin# A4.

MATLAB SIMULATION:



PID values:

Proportional = -2.1894

Integral = -3.1057

Derivative = -0.41

Hardware



Transfer function:

$$G(s) = \frac{1}{Ms^2 + fvs}$$

Result:

The ping pong ball levitates at the required height given by the some user.

FUTURE SCOPE:

- You can build your own PID control algorithm rather than importing the PID library.
- You can also research how to use a PID optimization library that will automatically choose parameter values for you.
- You can create a Python program that modeled the ball in the tube based on data from the Motion Detector.

APPLICATIONS:

The Ping Pong Ball levitation phenomena is a wonderful example of Bernoulli's Principle.

Airplanes can fly because of Bernoulli's Principle. Air rushing over the top of airplane wings exerts less pressure than air from under the wings. So the relatively greater air pressure beneath the wings supplies the upward force, or lift, that enables airplanes to fly.