

# Design and Control Level Loop Based on Low Cost Embedded System

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## ABSTRACT

*In this paper research and design of a Proportional, Integral, and Derivative (PID) Controller that uses a microcontroller Arduino uno platform. Arduino-based PID controller designed to control the level, consists of hardware parts: Arduino UNO, Ultrasonic Sensor, I-P Converter, P-I Converter and Control valve (Air to open) with pneumatic actuator and software includes C/C++ programming. The Designed system can effectively measure the level with an error while a stable level control with only slight deviation from the desired value (setpoint) is achieved. The design and control of level loop is very important in the various industries. The control loops are important for maintaining the stability of a system for consistently producing the desired outcomes. The main objective is to design and apply a PID controller to monitor and control the liquid level in a tank by using Arduino microcontrollers.*

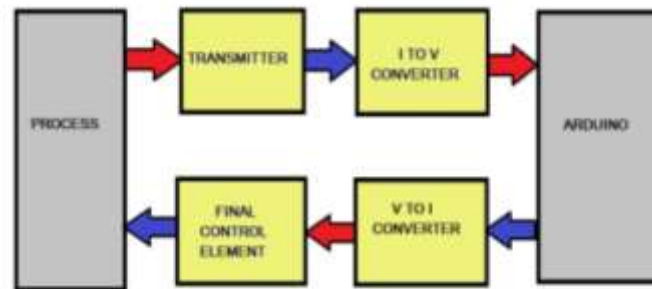
**Keywords:** Arduino Uno, Level Transmitter, Control Valve, V to I Converter, I to V Converter, I to P Converter.

## 1. INTRODUCTION

Modern industry, scientific workstations, robotics, and regular activities have been greatly Aided by the use of control systems. The extensive use of the control systems is evident in the Cruise control of vehicles, the water level control, the level control of petroleum products, the mobile control of robots, and many more applications in Countless scientific research and industries. The PID algorithm is a simple process, which is easy To understand conceptually and implement practically. The advantageous cost/benefit ratio Provided by the PID controllers makes them the most frequently used control tools in industry. The PID controllers have been extensively used since 1980s for the control engineering practice. The PID controller has been suggested as the second most important control decision and Communication instrument of the 20<sup>th</sup> century only behind the “Microprocessors.”

In this project we are going to implement the PID Controller Loop over level Control by using Arduino Uno as main controller. To Sense or measurement of that level of tank we are going to use ultrasonic sensor. All these things are connected to Arduino and control action is generated by Set point, Kp, Ki, Kp and PV as per the programming.

## 2. SYSTEM DESCRIPTION



**Fig 1:** Block Diagram Representation

**Process:** The actual process in the industry may be a flow loop, pressure loop or level loop. The sensor which are placed in a process and that is used to sense the signal. This sensed signal is transmitted to the Arduino or our controller through the transmitter.

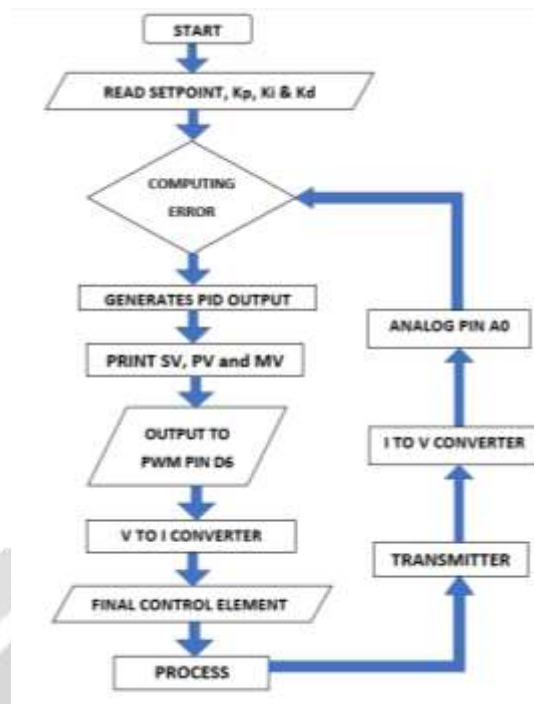
**Transmitter:** Transmitter is a device that converts the signal produced by a sensor into a standard instrumentation signal such as 3-15psi and 4-20mA. Level transmitter is used to measure and indicate level.

**I to V Converter :** The I to V converter module converts the current signal into a voltage. The transmitter sends the standard instrumentation signal which is 4 to 20 mA is converted into 0 to 5V because Arduino uno reads only 0 to 5 v signal.

**Arduino Uno:** Arduino uno is a microcontroller ATmega328P. It is a main controller to control this process. Arduino uno is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board. It receives sensed signal from the process through transmitter.

**V to I Converter :** V to I converter receives the signal from output of Arduino which is in the form of 0 to 5V. For operating control valve, the I to P converter used and its works on 4 to 20 mA current signal that's why here voltage to current converter is used.

**Final Control Element:** A final control element is a mechanical device that physically changes a process in response to a change in the control system setpoint. The final control elements mainly include the control valve, gates, dampers and our process are controlled by Arduino.



**Fig 2: Flow Chart Representation**



Hardware -

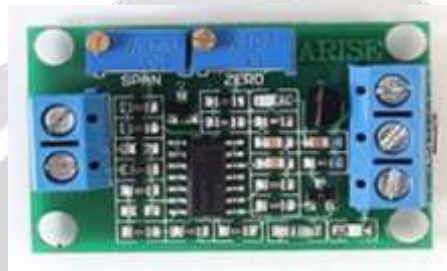
#### Arduino Uno:

Arduino uno is a microcontroller ATmega328P. It has 14 digital I/O pins (6 pins are PWM output), 6 analog input pins, 16 MHz quartz crystal. It has USB connection, an ICSP (IN Circuit Serial Programming) header, power jack and reset button.



#### I to V Converter:

This module is used for end of current signal transmission and it converts signal into voltage signal for single-chip detection. It supports current input 4-20 mA or 0-20mA and output voltage 0-3.3V, 0-5V and 0-10V. It converts the signal 5 to 0-20V.



#### V to I Converter :

This converter can convert industrial standard voltage to industrial standard current. Input 4-20mA, output 0-5V; the output has been calibrated and there is a potentiometer which can be used to finely adjust output valve. It converts the signal 5V to 0-20V.

#### Software

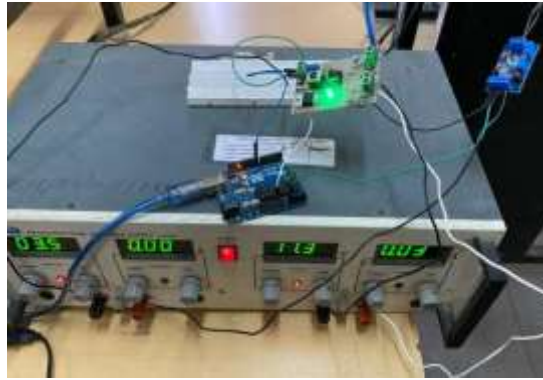
Arduino IDE: The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards.

### 3. RESULT

In this loop the transmitter is ultrasonic level transmitter which generates the standard 4-20 mA signal proportional to the liquid in the process tank.

Through programming in the Arduino, the PID controller (kp ki kd constants) the process variable compared with set point, controller take the control action and controlling the above process.





#### 4. CONCLUSION

This paper investigates a controlling process of Arduino uno based level control system and a brief information about the Arduino controller. In this project we replace the PLC controller to the Arduino uno because it is a less costly as well as consuming very small area. A level control system is a typical process control system, so understanding how level control system works necessary for us to know other design procedure in other industrial process control system. The PID controller is much better than the conventional controller because it is more intelligent than conventional controller. The PID control algorithm is already inbuilt in the Arduino IDE programming, so by using PID we get better result. Thus, we have controlled the level by using Arduino PID controller.

#### 5. REFERENCES

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