Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 9-10, 2024

Implementation of an Air Sampler Controller using Atmega128

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1. Introduction

A method to regulate the airflow rate of an air sampler can be implemented by applying a needle valve. This approach offers a simple configuration [1]. However, it does not allow for confirmation of proper functioning during power failures. To accurately sample the air, it is necessary to be able to monitor power outages as well.

Assuming that an air sampler system is nonlinear, controlling such systems that do not require fast response times can be simply implemented using a low-cost microprocessor. This method is simple, and easily applied feedback to systems [2, 3].

In this article, we present the implementation of an air sampler controller using a commercially available microprocessor. The Atmega128 is utilized to implement an air sampling controller due to its functional features. It provides analog-to-digital converter (ADC) modules for data acquisition, a pulse width modulation (PWM) module for motor control, an output port for liquid crystal display (LCD) control and the built-in electrically erasable programmable read-only memory (EEPROM) to show operating times and power outages [4].

2. Air Sampler Controller Implementation

2.1 Flow Rate Calibration

The output of the flow meter is measured in one channel of the ADC module in the microprocessor as shown in Fig. 1(a). Algorithms rely on saturation, quantization, and time delay techniques that are based on feedback signals. If the measured voltage (ADC-1) is lower than the reference value of the ADC-0 channel, the duty cycle of the PWM signal supplied to the pump is increased. Conversely, if the output voltage of ADC-1 is higher than the voltage of ADC-0, the duty cycle of the PWM signal supplied to the pump is reduced to track the reference voltage from ADC-0 as shown in Fig. 1(b). At this time, the reference voltage of ADC-0 can be adjusted by using the potentiometer in relation to the calibrated airflow meter. After completing the calibration by setting the reference voltage (ADC-0), the calibrated flow meter can be removed.

2.2 Power Outage Record

The method of adjusting the flow rate using a needle valve has the advantage of being simple and easy to operate [1]. However, in the event of a power failure, the operating time for air sampling cannot be confirmed, which reduces the reliability of sampling. One method to check for a power outage is to display the operating time or the counting number recorded in the EEPROM when the power is turned on. This method makes it easy to check for power outages. Because displaying the number of power-ups in the EEPROM and the operation time can verify proper operation.

2.3 Dual Air Pumps Operation

An air sampler can be used to sample the exhaust air discharged from the duct in the plant, as shown in Fig. 1(a). Assuming that the air pressure inside the duct is high, the air pump must generate sufficient pressure to maintain the flow rate for air sampling. The air sampler controller is designed to utilize up to two air pumps to ensure sufficient pressure. The PWM signal is transmitted to pumps, and the flow rate is adjusted based on the duty cycle of the PWM signal. The flow rate increases as the duty cycle increases.

3. Conclusions

An air sampler controller using the Atmega128 was implemented. The Atmega128 provides the ADC module for signal acquisition, a PWM module for dual motor control, an EEPROM for power failure checking, and IO ports for LCD control, offering ample functions to develop an air sampling controller. Compared to manually adjusting the flow rate using a needle valve, the reliability of sampling can be enhanced by utilizing a microprocessor, such as the Atmega128.

REFERENCES

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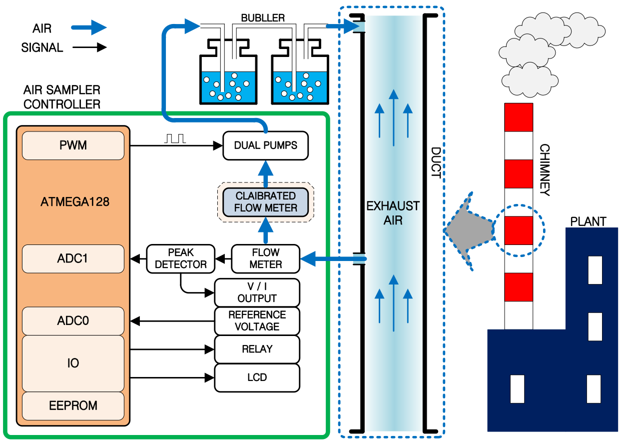
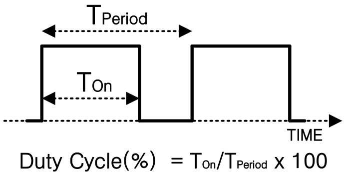


(a)



(b)

Fig. 1. (a)Function block diagram of the air sampler controller (b) Duty cycle.

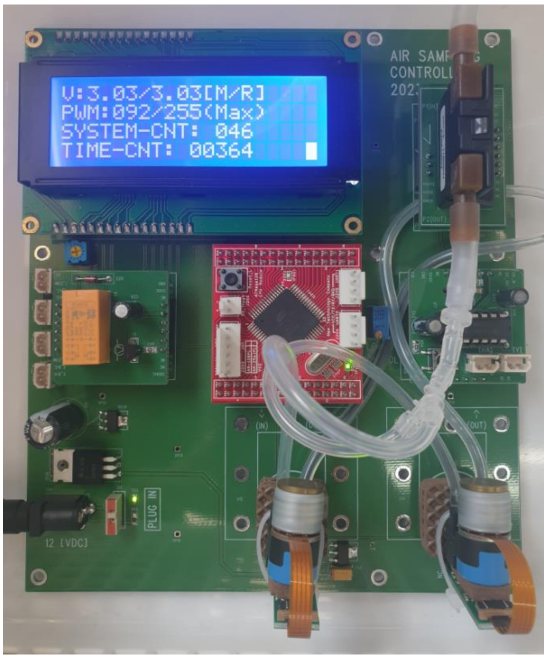


Fig. 2. Implemented air sampler controller