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MODERN APPROACHES TO AUTOMATED BARRIER CONTROL: THE CASE OF THE HW-201 SENSOR

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Abstract:

This article explores the development of an automated barrier control system using the HW-201 IR sensor. The project is based on the Arduino Nano microcontroller and a servo motor, with detailed descriptions of the system's technical specifications and operational principles. The system is designed to efficiently manage vehicle flow, enhance security, and reduce labor costs. Compliant with international standards such as ISO 12100 and IEC 61508, the solutions align with global automation practices. The simplicity of the software and the flexibility of the hardware components enhance the system's reliability.

Keywords: HW-201 IR Sensor, Arduino Nano microcontroller, automated barrier control system, servo motor, technical specifications, international standards (ISO 12100, IEC 61508).

Introduction

Automation has become an integral part of modern industries and services, significantly improving efficiency and reliability. Among its many applications, automated barrier control systems are essential in managing vehicle access in parking lots, industrial facilities, and residential complexes. This article focuses on the development of such a system using the HW-201 IR sensor and Arduino Nano microcontroller. The project demonstrates how modern automation tools can simplify operations, enhance security, and reduce manual labor. By leveraging a servo motor and integrating reliable components, the system ensures optimal functionality while adhering to international standards like ISO 12100 and IEC 61508. This work highlights the significance of automation in streamlining processes and its potential to meet global benchmarks for efficiency and safety.

Fundamental principles of automation

Automation systems in modern industries and services must be developed in compliance with international standards to ensure high efficiency. These systems are founded on three core principles: safety, efficiency, and adaptability.

Safety is the most critical requirement of automation, ensuring the minimization of risks from accidents or failures. Standards such as ISO 12100 and IEC 61508 provide clear guidelines for creating safe systems. These requirements emphasize the reliable performance of all system components, including sensors, control modules, and actuators.

Efficiency refers to the system's ability to optimize processes while minimizing energy consumption. A system built using the HW-201 IR sensor and Arduino microcontroller significantly reduces power usage and enables automated control. This is particularly crucial in transportation management systems, where resource savings are of paramount importance.

Another essential principle is *adaptability*. Systems must be flexible to accommodate changing demands and conditions. Programmable control elements like the Arduino platform allow systems to be easily customized for various applications and requirements.

In conclusion, automation systems designed following these principles deliver efficient, safe, and sustainable solutions. This ensures compliance with international standards and supports their wide application in global automation practices.

HW-201 IQ Sensoring features

The IQ sensor uses infrasound waves to detect movement in the environment and sense objects. This device is ideal for automatic control systems, enhancing their reliability.

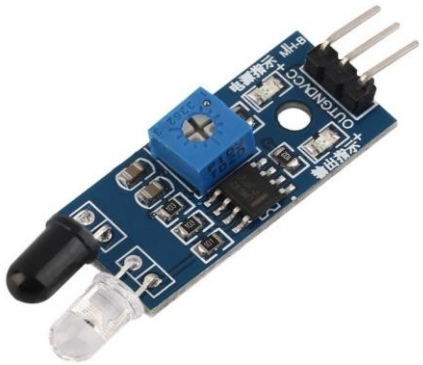

Figure 1: HW-201 IQ sensor

Advantages of the sensor:

- Low power consumption.
- High sensitivity.
- Direct integration with the Arduino platform.

System architecture

The system structure consists of three main blocks:

1.Sensor module – detects motion and sends a signal to the Arduino microcontroller.

2.Processing unit (Arduino) – processes the signal and sends control commands to the servo motor.

3.Actuator (servo motor) – ensures the opening or closing of the barrier."

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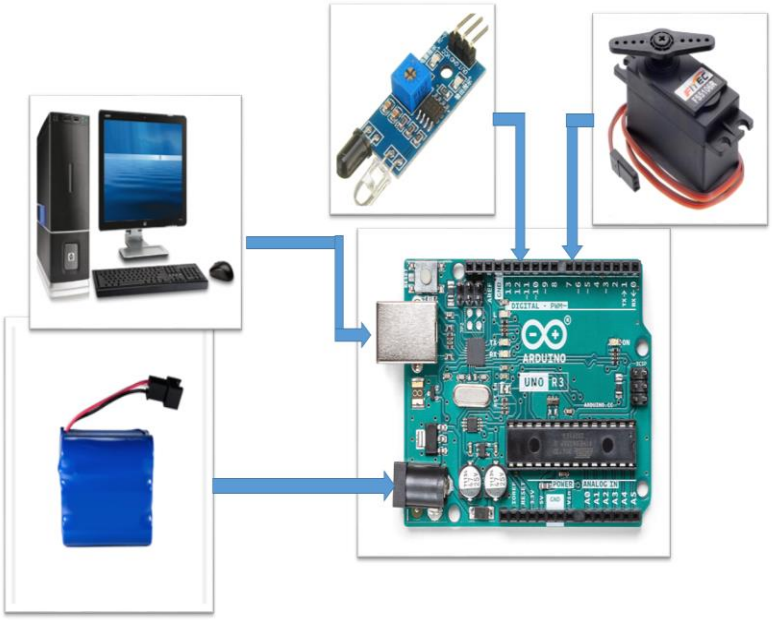

Figure 2: System architecture

Software

The software written on the Arduino platform ensures the functional operation of the system. This program has a simple structure and defines appropriate response actions for each sensor movement.

```
#include <Servo.h>
 Servo Serv;
 int pinIR=5;
 int pinServo=3;
 int val=0;
 void setup(){
  Serv.attach(pinServo);
 }
 void loop(){
  val = digitalRead(pinIR);
  if (val ==0){
   Serv.write(150);
   delay(100);
  }
  else
  {
```

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```
    Serv.write(10);
    delay(100);
  }
}
```

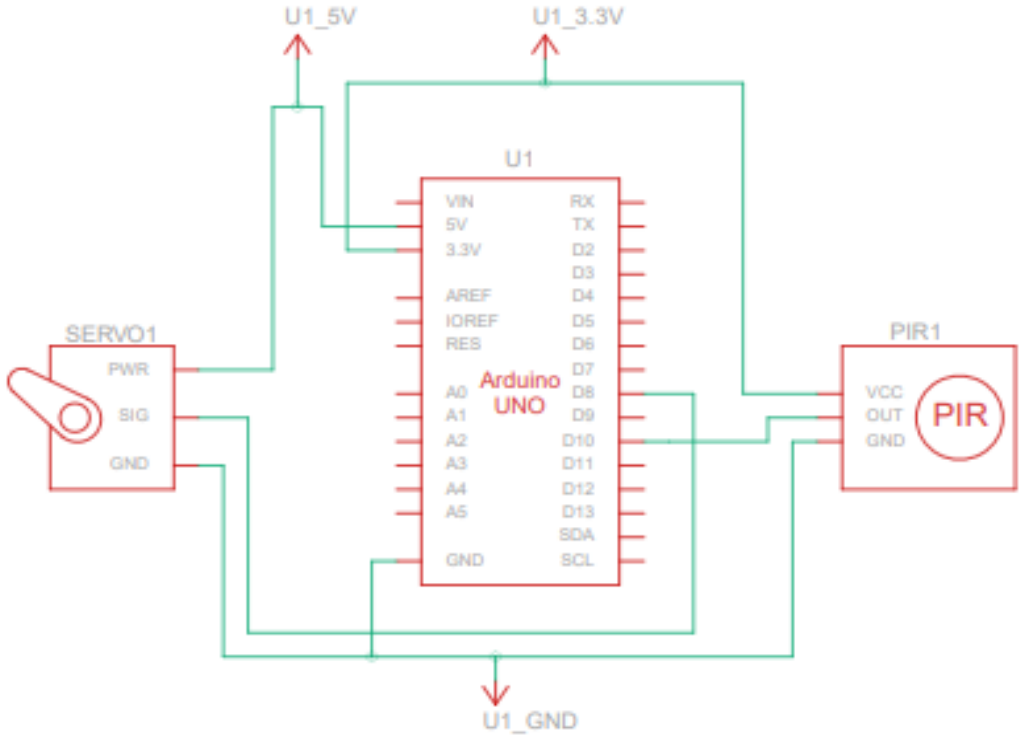

Figure 3: Principal circuit diagram based on Arduino software

Practical applications

Automation systems, including automated barrier control, have extensive applications across various industries and services. These systems are particularly effective in parking facilities, industrial complexes, residential areas, and high-security zones. By integrating technologies like the HW-201 IR sensor and Arduino Nano microcontroller, they ensure seamless operation, enhanced security, and reduced manual intervention.

For example, in transportation management, automated barriers facilitate efficient vehicle access control, minimizing congestion and optimizing resource use. Similarly, in industrial automation, such systems can regulate the flow of vehicles or equipment, ensuring safe and precise operations.

Compliance with international standards such as ISO 12100 and IEC 61508 further enhances the reliability and scalability of these systems, making them suitable for global implementation. Their adaptability also allows customization for diverse environments, from urban

infrastructure to remote industrial sites, contributing to their widespread adoption in modern automation.

Conclusion

The automatic barrier control system developed based on the HW-201 IQ sensor and the Arduino Nano microcontroller represents an effective example of modern automation solutions. This system reduces manual labor, enhances safety, and enables efficient resource utilization. Compliance with international standards (ISO 12100, IEC 61508) ensures the system's reliability and broad applicability.

This technology can serve as an efficient solution in areas such as traffic management and industrial automation, contributing not only to energy savings but also to increased productivity. Systems like this, developed with modern approaches, lay the foundation for future innovations in the field of automation.

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