

# ATMega328p Register Level Sensor Integration

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July 22, 2024

## Abstract

This report presents the project on integrating sensors at the register level using an ATMega328p microcontroller. The project features an ultrasonic sensor, LED, buzzer, and a slide switch, and is simulated using Wokwi, an online Arduino simulator.

## 1 Project Overview

The project demonstrates the use of the ATMega328p microcontroller for sensor integration at the register level. The primary components include an ultrasonic sensor for distance measurement, an LED for visual feedback, a buzzer for audible alerts, and a slide switch for mode selection. The project is simulated and tested on Wokwi.

## 2 Project Aims

- To integrate various sensors and actuators using the ATMega328p microcontroller.
- To implement register-level control for accurate sensor readings and actuator responses.
- To simulate and validate the project using Wokwi to ensure functionality before hardware implementation.

## 3 Major Features

- **\*\*Ultrasonic Sensor (HC-SR04):\*\*** Measures distance and provides output for further processing.
- **\*\*LED:\*\*** Lights up to indicate distance thresholds.
- **\*\*Buzzer:\*\*** Emits sound for alerting based on distance readings.
- **\*\*Slide Switch:\*\*** Toggles between different operational modes.

## 4 Project Setup and Connections

### 4.1 Components Used

- Arduino Uno (ATMega328p)
- HC-SR04 Ultrasonic Sensor
- 220 Ohm Resistor
- Red LED
- Buzzer
- Slide Switch

### 4.2 Connections

- **\*\*Ultrasonic Sensor:\*\***
  - GND to Arduino GND
  - VCC to Arduino 5V
  - ECHO to Arduino Pin 2
  - TRIG to Arduino Pin 3
- **\*\*LED:\*\***
  - Cathode (C) to Arduino GND
  - Anode (A) through a 220-ohm resistor to Arduino Pin 4
- **\*\*Buzzer:\*\***
  - Negative terminal to Arduino GND
  - Positive terminal to Arduino Pin 5
- **\*\*Slide Switch:\*\***
  - Terminal 1 to Arduino GND
  - Terminal 2 to Arduino Pin 6
  - Terminal 3 to Arduino 5V

## 5 Libraries Used

- **\*\*AVR Standard C Time Library\*\***

## 6 Steps to Simulate

1. Open the Wokwi project simulation link: <https://wokwi.com/projects/290056311044833800>.
2. Press the green "Play" button to start the simulation.
3. Observe the sensor readings and the corresponding LED and buzzer outputs.

## 7 Code Description

The project uses register-level programming to manage sensor input and control outputs. Key aspects of the code include:

- Configuration of timer and interrupt settings for sensor data acquisition.
- Control of the LED and buzzer based on distance measurements.
- Handling of the slide switch to toggle operation modes.

## 8 Results

### 8.1 Simulation Output

Below is a screenshot of the Wokwi simulation output.

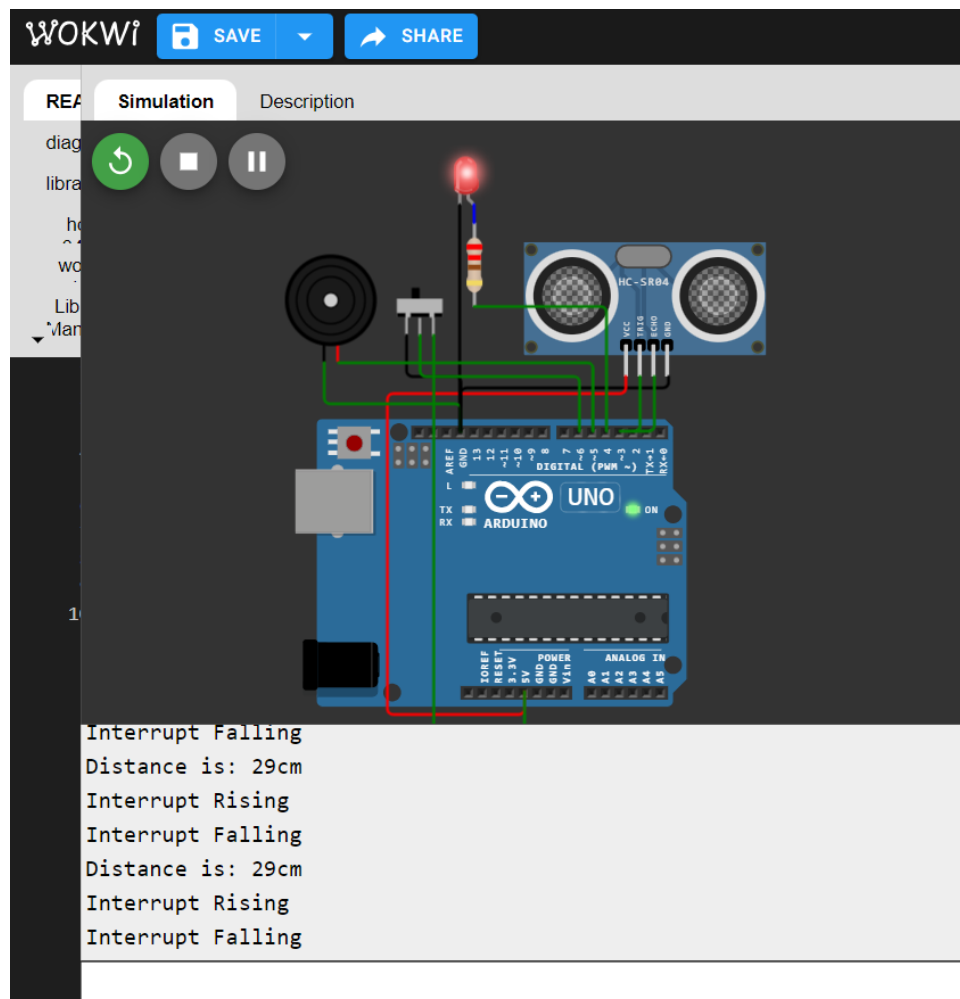


Figure 1: Wokwi Simulation Output

### 8.2 Observations

The simulation results demonstrate that the ultrasonic sensor correctly measures distance and triggers the LED and buzzer based on the distance values and mode settings.

## 9 Conclusion

This project successfully integrates an ultrasonic sensor with an ATMega328p microcontroller using register-level programming. The simulation on Wokwi confirms the functionality of the sensor integration and output control.

## 10 References

- AVR Standard C Time Library Documentation
- Wokwi Documentation: <https://docs.wokwi.com/guides/libraries>