Storing Data on the ATmega328P

TECH 3230 – Lecture 9

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Presentation created with a little help from ChatGDP

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ATmega328P Memory Overview

- SRAM (RAM): Temporary variables and stack storage
- Flash Memory: Program code and constant data
- EEPROM: Non-volatile storage for settings and calibration
- Each memory type has different speed and persistence

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SRAM (RAM) Basics

- SRAM is volatile memory
- Data is lost when power is removed
- Used for variables, arrays, buffers, and stack
- ATmega328P contains 2 KB SRAM

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Storing Values in SRAM

- Variables are normally stored in SRAM
- Example C code:
- int sensorValue = 100;
- char message[] = "Hello";
- Variables can be changed during program execution

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Flash Memory Basics

- Flash memory stores program instructions
- Non-volatile memory
- ATmega328P contains 32 KB Flash
- Useful for constant lookup tables and strings

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Storing Constants in Flash

- Use the PROGMEM keyword
- Flash storage saves valuable SRAM space
- Example:
- const char text[] PROGMEM = "Embedded C";

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Reading Data from Flash

- avr/pgmspace.h provides Flash access functions
- Example code:
- char c = pgm_read_byte(&text[0]);
- Functions are needed because Flash uses separate memory access

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EEPROM Basics

- EEPROM is non-volatile memory
- ATmega328P contains 1 KB EEPROM
- Useful for storing configuration settings
- Data remains after power loss

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Writing and Reading EEPROM

- Include <avr/eeprom.h>
- Write example:
- eeprom_write_byte((uint8_t*)0, 55);
- Read example:
- uint8_t value = eeprom_read_byte((uint8_t*)0);

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Comparing Memory Types

- SRAM: Fast, temporary, limited size
- Flash: Large, non-volatile, mostly read-only
- EEPROM: Non-volatile, slower writes, limited write cycles
- Choose memory type based on application needs

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Complete Example Program

```
#include <avr/io.h>
#include <avr/eeprom.h>
#include <avr/pgmspace.h>
const char msg[] PROGMEM = "Flash Text";
uint8_t EEMEM savedValue;
```

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Summary

- SRAM stores temporary runtime data
- Flash stores program code and constants
- EEPROM stores persistent settings
- Efficient memory usage is critical in embedded systems

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Lab Exercise

- Create a program that:
  - Stores a counter variable in SRAM
  - Stores a text message in Flash using PROGMEM
  - Saves a user setting in EEPROM
  - Reads the EEPROM value after reset