CE211-L Circuit Analysis Lab

Kickoff Report

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Semester: 3rd

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Classroom Environment Controller (CEC)

CE211 – Circuit Analysis | Project-Based Learning

1. Introduction

Our project proposes a **Classroom Environment Controller**, a simple but effective system designed to automatically adjust basic environmental conditions inside a classroom. The system focuses on three fully CE211-compliant features:

1. **Automatic Light Control** – Lights turn ON when ambient light is low and OFF when sufficient light is present.

2. **Temperature-Based Fan Control** – The fan switches ON when the classroom becomes hot and OFF when the temperature falls.

3. **Presence Detection (IR Beam Break Sensor)** – A basic entry-detection mechanism that identifies when someone enters the room by breaking an infrared beam.

The project intentionally avoids components outside the scope of CE211 — such as op-amps, comparators, microphones, or PWM motor drivers — and relies only on **logic gates, simple sensors (LDR/thermistor/IR pair), voltage dividers, and transistor switches**.
This makes the system fully achievable while still demonstrating practical applications of digital logic in real-world automation.

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2. List of Equipment / Tools Utilized

Sensors & Components

- LDR (Light Dependent Resistor)

- Thermistor (NTC)

- Infrared LED + Photodiode pair (IR break-beam system)

- Resistors (for voltage dividers)

- Transistors (NPN, e.g. 2N3904 or 2N2222, as switches)

- Diodes (for fan back-EMF protection if needed)

- Small DC fan (5V/9V/12V depending on design)

- LED(s) for indication

- Breadboard and connecting wires

Logic Components

- Logic gate ICs (e.g., 74xx NAND, NOR, NOT, AND)

- Power supply (5V logic source)

Tools

- Multimeter

- Breadboard kit

- Wire stripper

- Simulation software (optional: Logisim, Multisim)

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3. Expected Outcome

By the end of the project, the system should achieve the following:

Automatic Light Controller

- Light turns ON when LDR detects low light (after threshold is reached).

- Light turns OFF when ambient brightness is sufficient.

- Threshold determined using voltage divider and logic-level switching.

Temperature-Based Fan Controller

- Fan switches ON when thermistor senses high temperature.

- Fan remains OFF when the room is cool.

- Threshold implemented using Boolean logic and a transistor switch.

Presence Detection System

- IR beam breaks when a person enters.

- This triggers an indicator LED or logic HIGH output that can integrate into other systems.

- Demonstrates sensor-to-logic conversion and basic digital interfacing.

Overall System Outcome

A simple **smart classroom prototype** demonstrating CE211 concepts:

- Boolean decision-making

- Logic gate implementation

- Sensor-to-logic interfacing

- Basic transistor switching

The system should clearly show how **combinational logic + basic sensors** can automate parts of an environment.

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4. References

- Boylestad, R. & Nashelsky, L. *Electronic Devices & Circuit Theory*. 11th Ed.

- Electronics Tutorials — LDR and Thermistor voltage divider basics

- 74xx Series Logic Gate Datasheets (Texas Instruments)

- IR Break Beam Sensor Fundamentals (Adafruit / SparkFun

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5. Timeline (4 Weeks)

Week 1 — Research & Design

- Finalize block diagrams

- Decide threshold resistor values

- Assign tasks among group members

- Prepare initial Boolean logic design

Week 2 — Component Testing

- Test LDR voltage divider

- Test thermistor divider

- Test IR LED + photodiode

- Test transistors as switches

- Verify logic IC behavior

Week 3 — System Integration

- Combine sensors with logic ICs

- Implement threshold-based ON/OFF logic

- Mount fan and light circuits

- Begin breadboard-level prototype

Week 4 — Final Testing & Documentation

- Full system testing

- Debugging

- Final demonstration circuit

- Report writing and preparation of final presentation