CPE Final

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1 Introduction

This document outlines the conception, construction, and evaluation of a Smart Airflow Control System, informally known as a swamp cooler, developed for an embedded systems engineering course. Leveraging an Arduino Mega 2560 and various sensors, the system was designed to provide an affordable and low-energy cooling mechanism, particularly for arid environments. It incorporates environmental monitoring, automated ventilation, liquid level detection, and adjustable airflow. The following pages explore the system's structure, functionality, encountered issues, and testing outcomes.

2 System Design

The system cycles through four operational states: MONITOR, ACTIVE, FAULT, and OFFLINE. Transitions are governed by live sensor readings. Key hardware includes: - Arduino Mega 2560: Main processor for handling logic - DHT11 Sensor: Captures atmospheric data - Liquid Sensor: Detects insufficient water - Stepper Motor: Alters airflow direction - 16x2 LCD Panel: Communicates system conditions - Cooling Fan: Engages for air circulation - RTC Module: Logs operational timestamps

3 Circuit Layout

The hardware wiring is diagrammed in Figure 1, which shows how the control board interfaces with sensors, LEDs, and output devices.

4 Testing

Scenario 1: Standard Use Case - Initial Condition: System is idle, readings shown on screen. Smart Airflow Control System Report - Trigger: Temperature surpasses limit. - Outcome: Transitions to ACTIVE, blue light activates, fan runs, vent repositions. Scenario 2: Dry Tank Condition - Initial Condition: System cooling environment. - Trigger: Low water detected. - Outcome: Switches

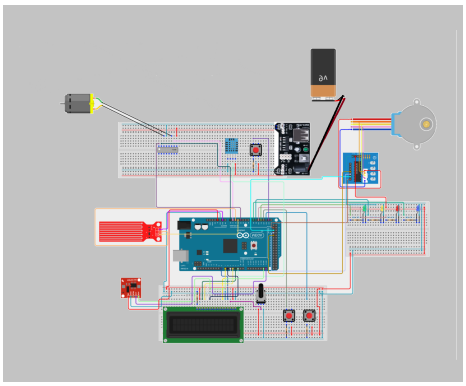

Figure 1: Figure 1

to FAULT, red light flashes, alert shown on screen. Scenario 3: User Shutdown - Initial Condition: Any non-offline state. - Trigger: Stop button is engaged. - Outcome: Halts operations, enters OFFLINE, yellow LED turns on.

5 Obstacles and Changes

Fan Reliability - Issue: Inconsistent fan activation at startup. - Fix: Checked circuitry and added boot-up delay code. Sensor Accuracy - Issue: Water sensor gave incorrect values during removal. - Fix: Added software filtering and maintained sensor cleanliness

6 Summary

The project met its design objectives, integrating sensors and actuators for intelligent cooling. It operated smoothly, adjusted based on environment, and offered user interaction. This system exemplifies how embedded design can improve energy efficiency.

7 Available Alterations

Upgrade to DHT22 for better sensing accuracy - Employ a sturdier and more responsive fan

8 Project Files

- Code Repository: CODE
  - Demonstration Video: VIDEO