CPS_for_Industrial_Applications_Project _Batch_56

PROJECT NAME: Intelligent Bathroom Ventilation Fan Controller

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Project Github Link: https://github.com/Chandu12867/SVCET_BATCH_56_III_ECE

Aim of the Project:

The aim of this project is to design and implement an intelligent bathroom ventilation fan controller that automatically adjusts fan operation based on occupancy and humidity levels to optimize ventilation and minimize energy consumption. The system will utilize sensors, a microcontroller, and a web interface to provide real-time data acquisition, control, and monitoring.

Problem Statement and Solution:

Problem Statement:

Traditional bathroom ventilation fans use manual on/off switches, which can lead to energy wastage and inadequate ventilation. There is a need for a more efficient and automated system to ensure proper ventilation while minimizing energy use.

Solution:

Develop an intelligent ventilation fan controller that integrates sensors to detect occupancy and humidity levels. The system will automatically adjust the fan operation to optimize ventilation. Additionally, a web interface will be developed for real-time monitoring and remote control.

Project Design Specification:

Hardware Components:

Microcontroller (e.g., Arduino, ESP8266/ESP32)

Humidity sensor (e.g., DHT22)

Occupancy sensor (e.g., PIR sensor)

Temperature sensor (e.g., DS18B20)

Ventilation fan

Relay module for fan control

Wi-Fi module (if not using ESP8266/ESP32)

Power supply

Software Components:

Microcontroller firmware

Web server and user interface

Data logging and visualization tools

Functional Requirements:

Continuous monitoring of humidity and temperature

Occupancy detection

Automatic fan control based on sensor data

User-friendly web interface for real-time monitoring and control

Energy-efficient operation

Project Architecture:

Sensors:

Humidity Sensor: Measures the moisture level in the bathroom.

Occupancy Sensor: Detects presence in the bathroom.

Temperature Sensor: Measures the temperature in the bathroom.

Microcontroller:

Processes data from the sensors.

Controls the relay to turn the fan on or off based on sensor inputs.

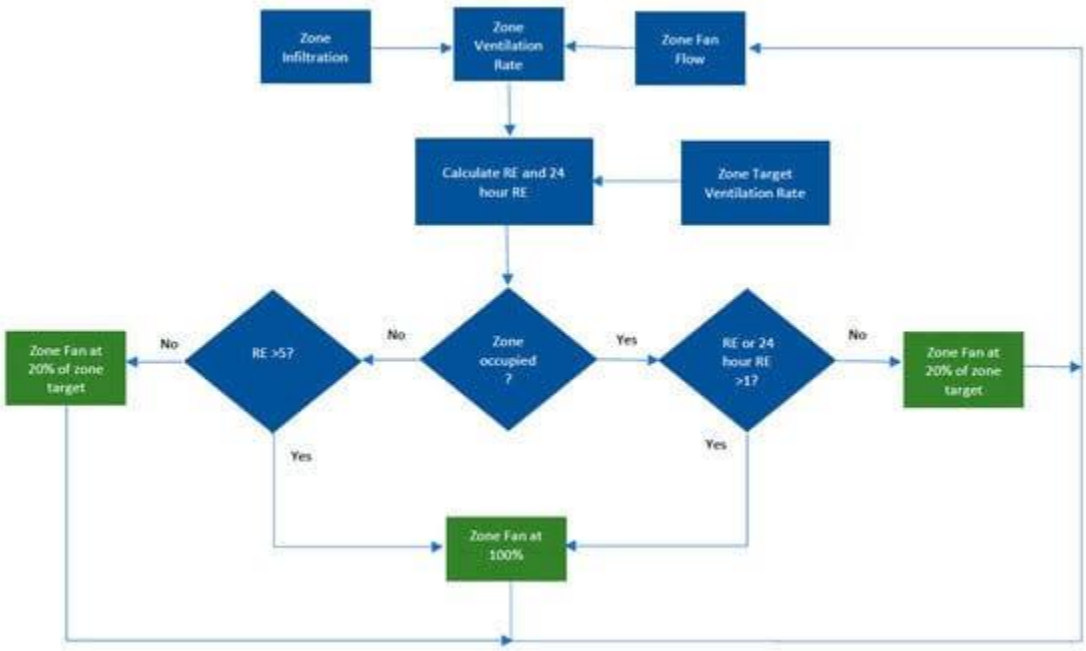
Communicates with the web interface via Wi-Fi.

Web Interface:

Displays current environmental conditions (temperature, humidity, occupancy status).

Allows users to manually override the fan operation if needed.

Accessible from any internet-enabled device.



Flow Explanation:

Initialization:

Power on the system.

Initialize sensors and Wi-Fi connection.

Data Acquisition:

Continuously read data from humidity, temperature, and occupancy sensors.

Decision Making:

If the humidity exceeds a preset threshold or occupancy is detected, turn on the fan.

If the humidity drops below the threshold and no occupancy is detected, turn off the fan.

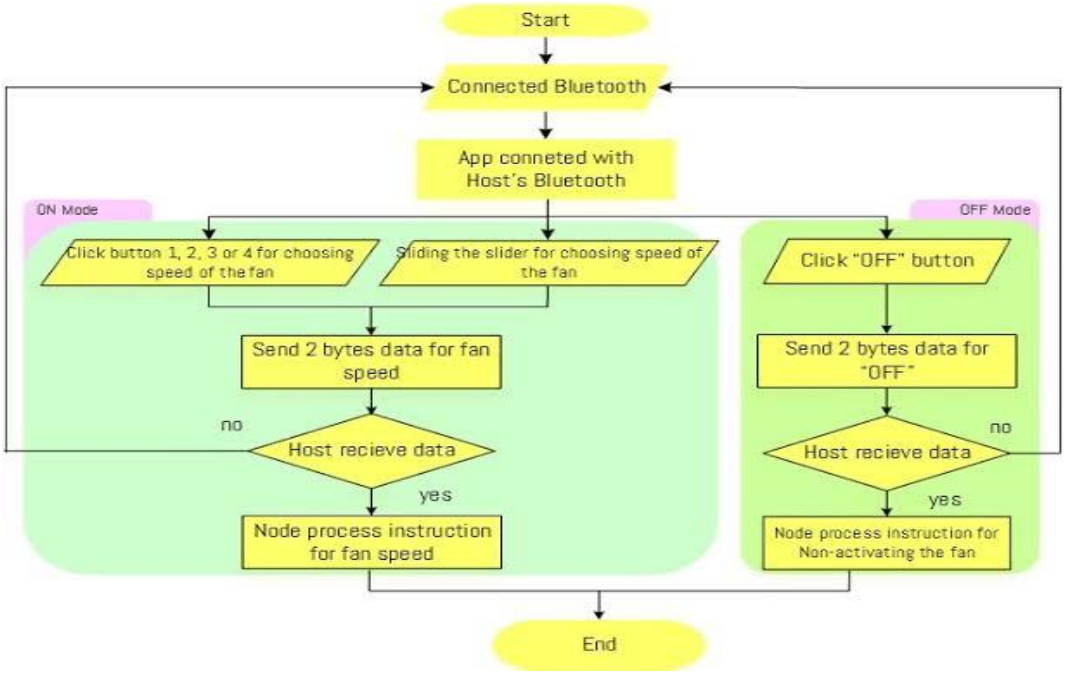
Data Transmission:

Send the sensor data to the web server.

Update the web interface with the latest data.

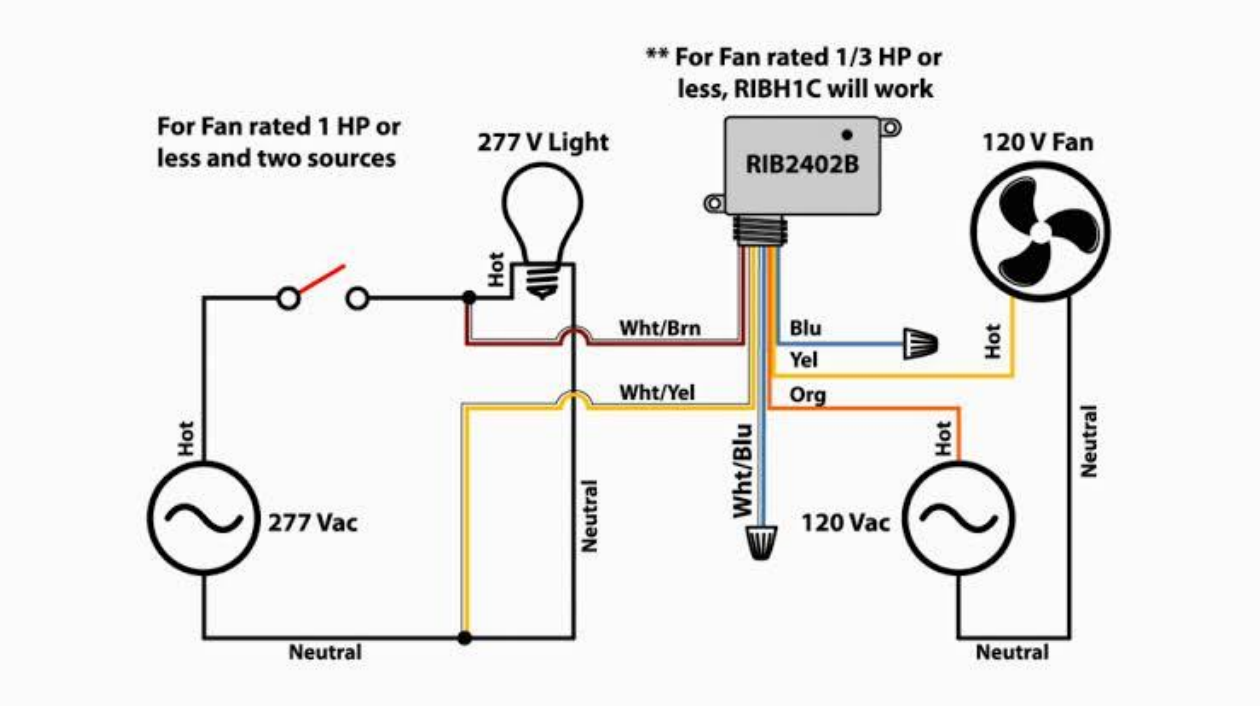
User Interaction:

Users can view real-time data and control the fan via the web interface.



Wiring Diagram:

The wiring diagram will include connections between the microcontroller, sensors, relay, and fan.



Components Working Principles/Functionality:

Humidity Sensor (DHT22):

Measures the relative humidity in the environment.

Sends data to the microcontroller.

Occupancy Sensor (PIR Sensor):

Detects motion within a certain range.

Sends a signal to the microcontroller when motion is detected.

Temperature Sensor (DS18B20):

Measures the ambient temperature.

Sends data to the microcontroller.

Relay Module:

Acts as a switch controlled by the microcontroller to turn the fan on or off.

Microcontroller (ESP8266/ESP32):

Central processing unit of the system.

Reads sensor data, makes decisions, controls the relay, and communicates with the web interface.

Project Outcome:

The intelligent bathroom ventilation fan controller will:

Automatically adjust fan operation based on real-time humidity and occupancy data.

Provide a user-friendly web interface for monitoring and control.

Improve indoor air quality and prevent moisture-related issues.

Minimize energy consumption through intelligent control.