SIT 225 – DATA CAPTURE TECHNOLOGIES

TASK 9.1P

Indoor Temperature & Ventilation Optimizer

1. Introduction

Quality of air indoors is an important factor in students' daily lives that is usually not given much thought. Many students, especially those residing in tiny dorms or rentals often keep their windows shut for days or weeks on end due to weather conditions, noise, or simply forgetting. As a result, there is little if any fresh air flow in- which can lead to an accumulation of heat, humidity and high CO_2 levels. All of these conditions can lead to discomfort, decrease concentration while studying, and in the long term influence one's health.

The goal of this project is to develop a basic and inexpensive Indoor Temperature & Ventilation Optimizer. The proposed system will record indoor temperature, humidity and air quality within a student’s room on a continual basis. It will then inform students when the indoor environment is no longer comfortable, and prompt them to open a window or create airflow. By promoting low cost and simplicity, this project will demonstrate how a very basic suite of sensors can help develop a healthier and more productive place to study.

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2. Literature Review

Multiple studies have explored indoor air quality in relation to human performance. Research indicates that high CO_2 levels and humidity can contribute to drowsiness, headaches, and quality of work. For example, when classrooms lack ventilation, student concentration drops. Some commercial products, such as the Dyson Air Purifier and Nest thermostats, measure temperature and air quality, but they are far too expensive, typically ranging from 150 to 600 dollars and geared toward kids on a budget.

Research in academia suggests that a humidity level between 30-60% provides comfort and focus and that CO_2 levels less than 1000 ppm are also comfortable for focus. Higher levels of humidity and CO_2 make indoors feel "stale." While there are expensive sensors that can determine this with accuracy, there are low-cost sensors to provide reasonable estimates, such as an MQ-135 gas sensor and DHT22 temperature and humidity sensor. This project illustrates a simple proof-of-concept for students based on using these inexpensive components.

3. Methods

Sensors and Hardware:

- **DHT22 sensor** will be used for measuring air temperature and humidity. This sensor is widely available and inexpensive while still providing decent accuracy.
- **MQ-135 gas sensor** will approximate air quality by detecting gases such as CO_2, smoke, or other pollutants.

Data Collection Protocol:

- Sensors will be placed in a student room, ideally on a desk or shelf at breathing height.
- Readings will be taken every 5 minutes over a 24-hour period to capture daily patterns.
- Data will be logged both locally (CSV file) and uploaded to the Arduino Cloud for live dashboard visualization.

Dashboard and Visualization:

- A simple dashboard will be created using Arduino Cloud or Excel.
- Temperature and humidity will be shown as line charts over time.
- Air quality will be displayed on a separate chart with thresholds highlighted (e.g., green = good, orange = moderate, red = poor).
- If thresholds are exceeded (e.g., humidity > 70% or CO_2 levels indicating poor air quality), the system will flag “Open window” as a recommendation.

Analysis Plan:

- Calculate minimum, maximum, and average values for each sensor across the observation period.
- Compare readings to standard comfort thresholds.
- Identify times when ventilation was required and how often.

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4. Expected Results

The data should show some clear patterns in indoor air quality. For instance, CO_2 levels and potentially humidity will rise during the day when a student is present with the windows closed, and temperature will vary depending on the outdoor weather and activity happening in the room. In the evening, there is the potential for conditions to become steadier if the space is cooler and less active.

The dashboard will clearly reflect these changes, showing temperature rising throughout the day, humidity spikes after cooking or showering, and a drop in air quality after a few hours without ventilation. The system would notify you that levels were above recommended thresholds with a simple suggestion like "Open window." A summary table would show overall min, max, and average values, so the results are easy to read briefly.

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5. Discussion

The project shows that it can be done, tracking indoor comfort and air quality even with inexpensive sensors. Students will be anecdotally be able to utilize this information to make small adjustments, such as opening a window at the right time or changing how you ventilate the space and that can make differences in concentration and health. It’s a very simple system, but one that can change a students comfort and productivity level, because most are probably unaware of how quickly indoor air quality can decline in a confined room.

There are some limitations to the instrument. The MQ-135 is not as precise as industrial CO_2 sensors, and is likely susceptible to the effects of other gases. There are limited aspects of calibration so the system would act as an indicator primarily rather than an accurate measure. Another limitation is that this project too only monitors the environment, while not taking any action itself. Nevertheless, the value is to raise awareness and show that smart monitoring can be accessible, and does not have to be expensive.

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6. Future Work

Future improvements could make the system more advanced. For example:

- **Automation:** Connecting the sensors to a small fan that automatically switches on when air quality drops.
- **Notifications:** Sending alerts to a student’s phone or computer when the environment becomes uncomfortable.
- **Extra sensors:** Adding light or motion sensors to see how occupancy affects air quality.
- **Long-term monitoring:** Collecting data over weeks to understand seasonal differences.

These extensions would make the system more complete and move it closer to commercial-level functionality.

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7. Requirements and Budget

- Arduino Nano 33 IoT (provided in SIT225 kit)
- DHT22 temperature/humidity sensor (~$5)

- MQ-135 gas/CO_2 sensor (~$7)
- Arduino Cloud free account
- Dashboard tool (Arduino Cloud or Excel, free)

Total cost: ~$12 (sensors only, since the microcontroller is already available).

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8. Ethics

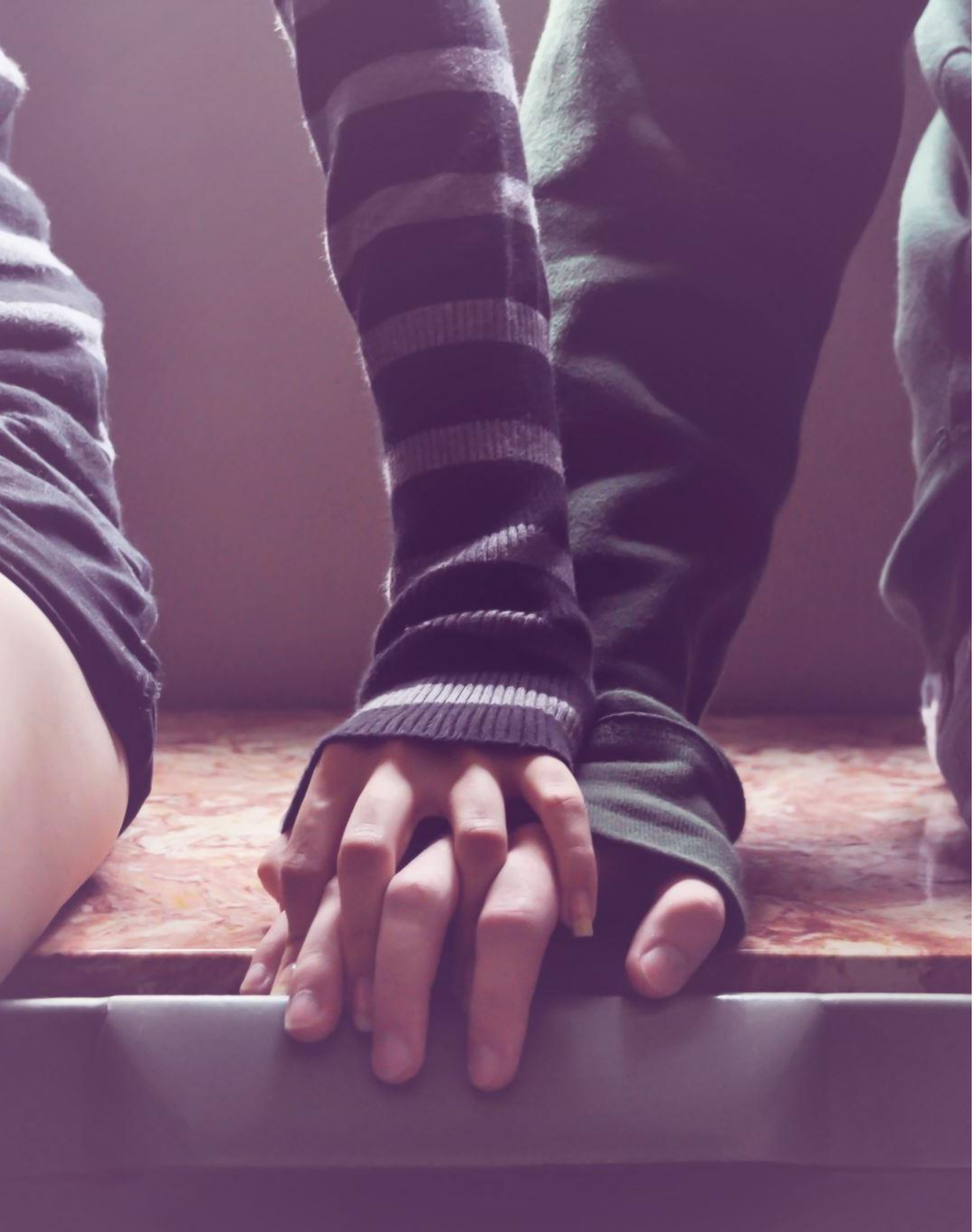
The project only collects environmental data such as temperature, humidity, and air quality. No personal information is recorded. The data will be stored in a private Arduino Cloud account and locally in CSV format. Risks are minimal. The main ethical consideration is ensuring that data is only used for personal monitoring and not shared without consent, especially if multiple people share a room.

Indoor Temperature & Ventilation Optimiser

Aditya Suhag – SIT225

Introduction

- Poor ventilation is common in small student rooms
- Closed windows ? higher temperature, humidity, and CO?.
- This impacts focus, health, and comfort.
- Aim: design a low-cost optimiser for better indoor conditions.



Problem

- Students often forget to open windows during long study sessions.
- Air quality drops in closed rooms, especially in small spaces.
- Results: discomfort, tiredness, reduced productivity.

Literature Review (brief)

- High indoor CO? is associated with reduced concentration.
- Comfortable humidity range is roughly 30–60%.
- Commercial monitors (e.g., Nest, Dyson) are effective but costly.
- Low-cost sensors (DHT22, MQ-135) provide basic yet useful insights.

Methods (Overview)

Sensors: DHT22 (temperature, humidity); MQ-135 (air quality proxy).

Placement: desk/shelf at ~breathing height in student room.

Sampling: every 5 minutes across 24 hours.

Storage: CSV locally + Arduino Cloud for live dashboard.

Dashboard Design

- Line charts for temperature and humidity over time.
- Air quality indicator with thresholds: Good / Moderate / Poor.
- Action rule: show “Open window” when thresholds are crossed.

Expected Results

- Temperature tends to rise in the afternoon; drops at night.
- Humidity spikes after cooking or showering.
- Air quality worsens with windows closed for long periods.
- Summary table: min, max, and average per variable.

Discussion

- Low-cost sensors can track comfort effectively for students.
- Creates awareness to ventilate at the right time.
- Limitations: low accuracy of cheap gas sensors; indicator not precise.
- System monitors only; no automatic actuation in this version.

Future Work

01

Automate ventilation (e.g., control a fan on poor air quality).

02

Send phone notifications when thresholds are exceeded.

03

Add occupancy/light sensors to correlate with air quality.

04

Long-term tracking across seasons for deeper insights.

Conclusion

- Indoor conditions strongly affect study performance and comfort.
- This low-cost design offers an affordable monitoring approach.
- Simple reminders (open window) can improve daily wellbeing.

Thank you!