Assignment 4.1 Applying the Engineering Design Process

1. Problem Identification

In a student boarding house near campus, the electricity bill has been increasing steadily month by month. After observing the situation, the landlord noticed that many students tend to leave electrical devices running even when not in use. Common issues include leaving lights and fans on when leaving the room, charging devices overnight or while away, and using appliances inefficiently (e.g., running an electric kettle multiple times unnecessarily).

Why is This a Problem?

Financial Impact- The landlord bears the cost of rising electricity bills, which could lead to increased rent or stricter utility rules.
Energy Waste- This behavior contributes to unnecessary electricity usage, which has both environmental and economic impacts.
User Behavior- Students often forget to turn off or unplug devices due to busy schedules or lack of awareness.

Who is Affected?

Landlord - Pays for the electricity and must deal with increasing utility costs.

Students - May eventually face restrictions, penalties, or increased rent.

Environment - Energy waste contributes to a larger carbon footprint.

2. Research

To develop an effective solution, it's important to understand the root causes of energy waste and what current technologies are available to help. Common Causes of High Electricity Usage are Idle Appliances or devices like chargers, microwaves, or fans are often left on unintentionally. Lack of Awareness or students may not realize how much energy each appliance uses. Inefficient Habits or running multiple appliances unnecessarily or using them for too long. Without tracking or real-time data, users have no idea how much electricity they're using. To address electricity waste in households or shared living spaces, several tools and technologies have already been developed. One common solution is the use of smart plugs. These are Wi-Fi-enabled devices that allow users to control appliances remotely through a mobile app. They often include features like timers, energy monitoring, and scheduling. While very effective, smart plugs can be somewhat expensive for students on a budget and may require technical setup. Another simple yet effective solution is the use of mechanical or digital timers. These devices

automatically cut off power after a set period, helping to prevent devices like fans or heaters from running longer than necessary. Timers are generally affordable and easy to use, but they lack flexibility and do not adapt to changing routines or user behavior.

3.Specify requirements

For the solution to be practical and sustainable within a student boarding house, it must meet three key requirements. First and foremost, it must be affordable. Most students live on a limited budget and are unlikely to invest in costly smart devices or advanced systems. Therefore, the solution should be either free or very low-cost. Second, the solution must be easy to use. Since not all students are tech-savvy, the system must require minimal technical knowledge and have a user-friendly interface. Ideally, it should work with tools students already use, such as smartphones. Third, the solution must be effective in reducing electricity waste. It should directly influence user behavior or provide automation that helps minimize unnecessary energy consumption. If the solution fails to reduce actual electricity usage or doesn't encourage change, it won't solve the problem.

4. Brainstorm 3 solutions

The first solution is a **mobile reminder app** that sends push notifications to students at certain times of the day (e.g., before bedtime) or when they leave the house (using GPS geofencing). These reminders prompt users to check and turn off their lights, fans, and chargers. The app would be lightweight, customizable, and compatible with Android or iOS devices, making it an affordable and accessible option.

The second solution is a **device usage tracking program** that allows students to manually log the usage time and wattage of their appliances each day. The program would calculate their energy consumption in kilowatt-hours (kWh) and estimate their daily electricity costs. This helps raise awareness about which devices consume the most power and encourages students to adjust their habits accordingly.

The third solution is a **smart power strip** (conceptual design) that automatically cuts off power when it detects that devices are in standby mode or unused. The power strip would have built-in sensors or timers and could be programmed to turn off after a certain period of inactivity. While this is the most automated and efficient solution, it would require a physical product to be designed and manufactured, making it less feasible for immediate implementation in a low-budget environment.

5. Best Solution Selection

After evaluating the three proposed ideas against the defined requirements, the mobile reminder app emerges as the most practical and beneficial solution for the student boarding house. It is cost-effective, as it can be developed for free or at minimal cost, and it utilizes smartphones that students already own. The app is also easy to use, requiring just a few taps to set up reminders based on time or location. Importantly, it promotes long-term behavioral change by making students more conscious of their energy usage habits. Although the other solutions like the device usage tracker or smart power strip offer additional insights or automation, they are either too manual or too expensive for this setting. The mobile app strikes the right balance between affordability, usability, and effectiveness in reducing electricity waste.

Conclusion

The increase in electricity usage within the student boarding house stems largely from human behavior specifically, forgetfulness and a lack of awareness about energy consumption. After exploring existing solutions and brainstorming new ideas, the mobile reminder app proves to be the best fit. It is affordable, simple, and effective at encouraging users to turn off appliances and unplug unused devices. Combined with a usage calculator and optional tips, the app provides a practical way to raise energy awareness and reduce power waste. This solution is easy to implement and has the potential to significantly lower electricity bills and contribute to more sustainable living habits among students. In the future, this idea could be expanded into a full mobile application using development platforms such as Flutter, MIT App Inventor, or React Native.