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Assignment-1

Engineering in Reverse! Activity – Engineering in Reverse Worksheet

Q 1) Reverse Engineer TV Remote for

a) Component functionality.

b) Component associativity with assembly.

c) 3-D- CAD Model / 3-D Printed Part

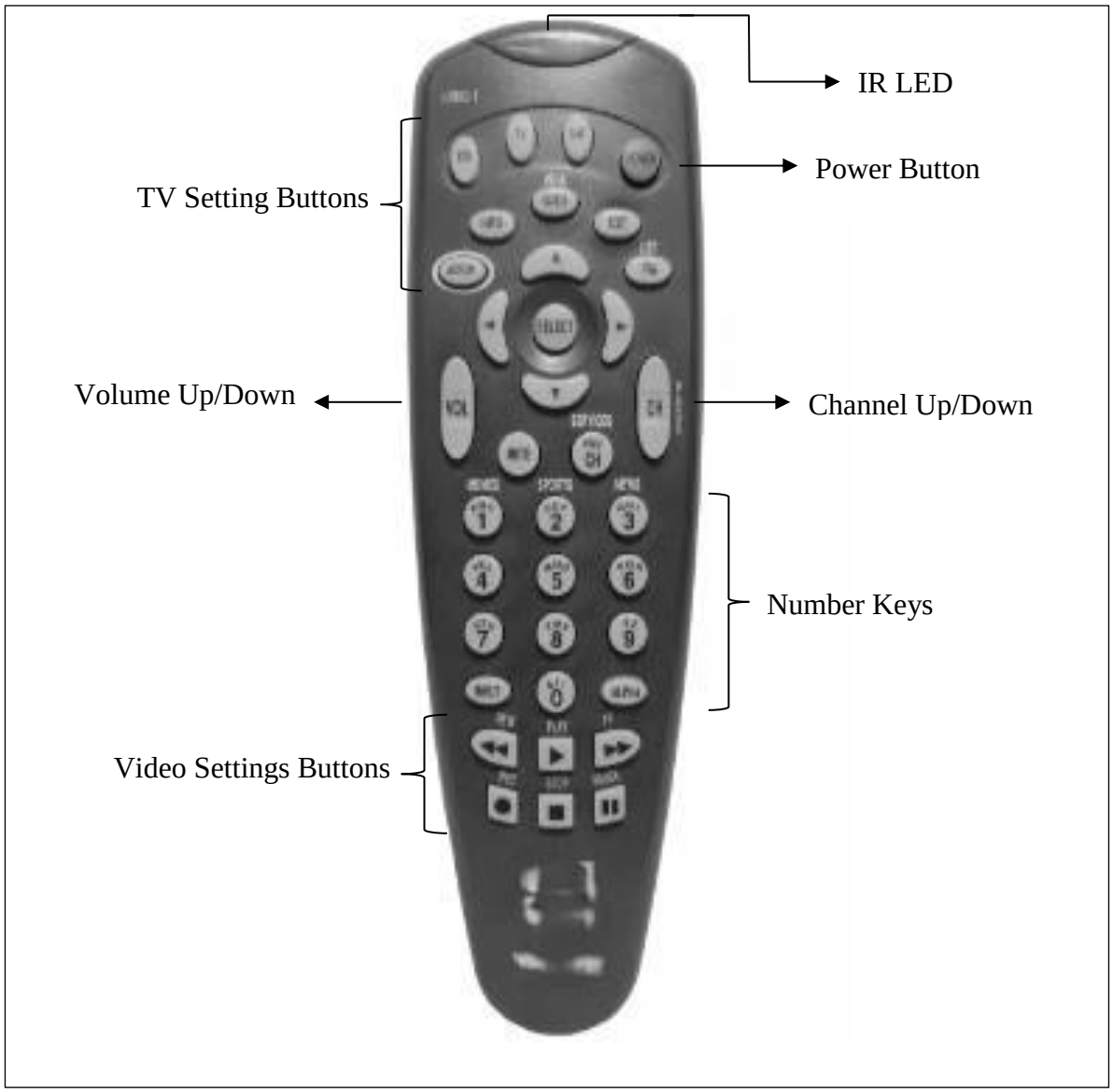
Name of the System/Device/Assembly: TV Remote

In the box below, complete a *detailed* drawing of the internal components

(i.e., the inside mechanisms) in the given system before it has been disassembled. Your drawing should include:

- Label for all parts
- Brief description of each part's function(s)

BEFORE Disassembly



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In the box below, complete a *detailed* drawing of the internal components of the given system after it has been disassembled. Your drawing should include:

- Label for all parts
- Brief description of each part's function(s)

AFTER Disassembly

a) Component functionality

Components:

- **Buttons:** These are the interface you use to give commands to the TV. Each button has a unique electrical signature.
- **Circuit Board:** This is the brain of the remote, containing *microprocessor* and *memory* that interpret button presses and generate the appropriate control signals.
- **Infrared (IR) LED (Light-Emitting Diode):** This tiny LED emits pulses of invisible infrared light that carry the encoded signal from the button press.
- **Battery:** Provides power to the entire circuit board and IR LED.

Functionality:

1. **Button Press:** When you press a button on the remote, it completes an electrical circuit on the circuit board.
2. **Signal Encoding:** The microprocessor on the circuit board recognizes the pressed button and translates it into a specific digital code.
3. **IR Signal Transmission:** The microprocessor sends the encoded signal to the IR LED.
4. **Light Pulses:** The IR LED rapidly pulses invisible infrared light according to the specific code for the pressed button.
5. **Transmission to TV:** The IR light pulses travel through the air towards the TV.
6. **IR Receiver in TV:** The TV has a built-in IR receiver that detects the incoming infrared pulses.
7. **Signal Decoding:** The receiver in the TV translates the received IR signal back into a digital code.
8. **Command Execution:** The TV's internal processor recognizes the decoded signal and performs the corresponding action, such as changing channels, adjusting volume, or turning the power on/off.

b) Component associativity with assembly

The seemingly simple TV remote relies on a well-assembled combination of components to function. The core assembly process involves the **circuit board**. This acts as the foundation, housing the **microprocessor** and **memory** chips. These chips are the brains of the remote, deciphering button presses and generating control signals.

The buttons are then soldered or connected via conductive films to designated points on the circuit board. Each button has a unique electrical signature, allowing the microprocessor to identify which button is pressed. A small **battery** is also secured within the assembly, providing power to the entire circuit.

Once the core components are assembled, the **Infrared (IR) LED** is strategically placed on the front of the remote, typically behind a clear plastic window. This positioning allows the LED to transmit the encoded signals wirelessly towards the TV. Finally, the housing of the remote is carefully assembled around the circuit board and components, ensuring everything is secure and protected during use. This completes the TV remote, with each part working together seamlessly to translate your button presses into commands for your TV.

c) 3-D-CAD Model / 3-D Printed Part

While 3D printing a fully functional TV remote with circuit board and electronics is complex, one can certainly create a custom case using a 3D printer. Here's a simplified process breakdown:

Design and Modeling:

1. **Define the Design:** Sketch or plan the desired remote design. Consider factors like size, button layout, and any aesthetic elements.
2. **Choose CAD Software:** There are free beginner-friendly options like Tinker cad or SketchUp, or more advanced software like Fusion 360 or Blender (with a steeper learning curve).

3. **Modeling the Case:** Use the chosen software to create a 3D model of the remote case. This involves designing the base shape, button placements, and any cutouts for the IR LED or other features.

3D Printing and Finishing:

1. **Export for Printing:** Export the final model in a format suitable for 3D printing, typically STL or OBJ.
2. **Slicing and Printing:** Use slicing software like Cura or PrusaSlicer to prepare the model for printing. Adjust settings like infill density and layer height based on desired strength and aesthetics. Choose your 3D printer and filament material.
3. **Printing and Post-Processing:** Print the remote case. Once complete, remove any support structures and clean up the print. One can sand, paint, or add decorative elements to personalize your 3D printed TV remote case.

3D Model of the Tv Remote

3D Printed Tv Remote

After you have completed your drawing, answer the following questions.

1) What does this device do? What parts make it work this way?

   The device is a **television remote control**. It allows you to wirelessly control your TV from a distance. The key components include: **buttons** you press to initiate commands, a **circuit board** that interprets these button presses and generates signals, an **infrared (IR) LED** that transmits encoded light pulses carrying the commands, and a **battery** that powers everything. When you press a button, the circuit board creates a unique code that the IR LED transmits as invisible light pulses. These pulses are received by the TV's IR sensor, decoded back into commands, and executed (like changing channels or adjusting volume).

2) How would you improve the way this device is made?

- **Enhanced Ergonomics:** The design could be more comfortable to hold for extended periods. This could involve a better fit for the hand, textured grips, or even customizable button layouts for individual preferences.
- **Voice Control Integration:** Built-in microphones could allow for voice commands alongside traditional buttons, offering a more hands-free experience.
- **Motion Control Integration:** Some remotes incorporate motion controls for navigating menus or playing games. This functionality could be further refined for a more intuitive user experience.
- **Universal Compatibility:** A truly universal remote that could control a wide range of devices (TVs, soundbars, streaming devices) with minimal setup would be a major convenience improvement.
- **Touchscreen or Hybrid Interface:** Replacing some buttons with a touchscreen could offer a more versatile and intuitive way to interact with the TV. However, some users might still prefer the feel of physical buttons, so a hybrid approach could be ideal.

- **Improved Battery Life:** More efficient designs or even rechargeable batteries could reduce the need for frequent battery replacements.
- **Smart Features:** Integration with smart home systems could allow the remote to control lights, thermostats, or other connected devices.
- **Eco-Friendly Materials:** Using recycled or sustainable materials in the manufacturing process could lessen the environmental impact of TV remotes.

3) How could you change this device to make it more cost effective to produce?

To make TV remotes more cost-effective to produce, manufacturers could focus on several aspects:

- **Simplified Design:** Reducing the number of buttons and streamlining the overall design can decrease material usage and assembly complexity. This could involve focusing on core functionalities and eliminating less frequently used buttons.
- **Standardized Parts:** Utilizing a smaller set of standardized buttons, circuit board components, and casings across multiple remote models could streamline production and potentially lower costs through bulk purchases.
- **Automation:** Investing in automation for repetitive tasks like circuit board assembly and component placement could increase production speed and potentially reduce labor costs.
- **Material Selection:** Using less expensive materials for the casing, like recycled plastic or even cardboard composites, could bring down production costs without compromising core functionality.
- **Reduced Packaging:** Minimizing or using recycled materials for packaging can further reduce overall production costs.

By implementing these strategies, manufacturers can create TV remotes that are more cost-effective to produce while still delivering the essential functionalities users expect.

4) Can you redesign this device to make it function differently? How would you do this?

Motion-Controlled and Voice-Activated Remote:

This redesigned remote would move beyond simple button presses. It could incorporate **motion sensors**, similar to those in gaming controllers, allowing users to navigate menus or control playback through hand gestures. Imagine swiping your hand up to increase volume or tilting the remote to rewind. Additionally, a built-in **microphone** would enable **voice commands**. Users could speak commands like "turn on the TV," "change to channel 15," or even "search for action movies" for a more intuitive and hands-free experience.

This redesign would require a more complex internal structure with the addition of motion sensors and a microphone. However, the benefits could be significant, offering a more natural and interactive way to control your TV. It could also be particularly useful for users with mobility limitations or those who prefer a hands-free approach.