**Understanding the Top Part of the System: Movement Detection Module**

**Goal of the System**

The primary goal of the top part of the system is to detect movement from end users using a series of sensors. This functionality allows the system to monitor and respond to changes in the environment based on user interaction or movement.

**Components Inside**

1. **16 Ultrasonic Sensors**
   * These sensors are strategically positioned to cover a wide detection area. Each sensor is capable of emitting ultrasonic sound waves and measuring the time it takes for the waves to bounce back after hitting an object, enabling accurate distance measurements and movement detection.
2. **Printed Circuit Board (PCB)**
   * The printed circuit board acts as the foundation for connecting and integrating all electronic components. It ensures organized wiring and stable connectivity between sensors and microcontrollers.
3. **Pro Micro Microcontroller**
   * The Pro Micro serves as the main microcontroller, managing data collection from the sensors and processing input. It sends data through serial communication to the main server or the next processing stage.
4. **MCP23017 I2C Port Expander**
   * The MCP23017 is used to expand the number of general-purpose input/output (GPIO) pins available, as the Pro Micro itself has limited GPIO capability. This expander ensures that all 16 sensors can be connected and managed efficiently.

**How It Works**

1. **Sensor Activation**: Each of the 16 ultrasonic sensors is connected to the system through the PCB and controlled via the Pro Micro. These sensors emit ultrasonic pulses and wait for the return signal to measure the distance to any object in front of them.
2. **Data Processing**: The Pro Micro collects the distance data from the sensors. If movement is detected (i.e., a change in the distance data that indicates a user's presence or motion), the microcontroller processes this input.
3. **GPIO Management**: The MCP23017 I2C Port Expander plays a crucial role in handling the signals from all 16 sensors. By expanding the Pro Micro's limited number of GPIO pins, the MCP23017 allows simultaneous connections for all sensors without compromising data integrity.
4. **Communication**: Processed data from the Pro Micro is transmitted via serial communication to a server for further action. This data transfer ensures that detected movement can trigger various responses, such as activating alerts, updating displays, or executing other system operations.
5. **LED Strip Activation**: When movement is detected, the system also sends a signal to connected LED strips. These LED strips have a base animation that plays during standby. When movement is detected, the animation changes to a different pattern, providing visual feedback that the system has registered interaction.

**Visual Representation**

Below is a simplified diagram that illustrates the layout and connections of the components within the top part:

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| Printed Circuit |

| Board |

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| 16 Ultrasonic |

| Sensors |

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| MCP23017 I2C |

| Port Expander |

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| Pro Micro |

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| LED Strips |

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**Summary**

This top part of the system is designed to detect user movement efficiently with the help of 16 ultrasonic sensors, a Pro Micro microcontroller, and an MCP23017 port expander. The PCB ensures seamless connectivity among all components, enabling the module to function as an effective movement detection system. Additionally, the LED strips provide visual confirmation of movement detection with a change from the base animation to an active animation.

Understanding this setup helps in both troubleshooting and optimizing the system for enhanced detection performance.

Afbeelding met elektronica, Elektronisch onderdeel, Elektronische engineering, Stroomkringonderdeel

Automatisch gegenereerde beschrijving