Smart Room

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Embedded Systems Final Design Project, Spring 2025
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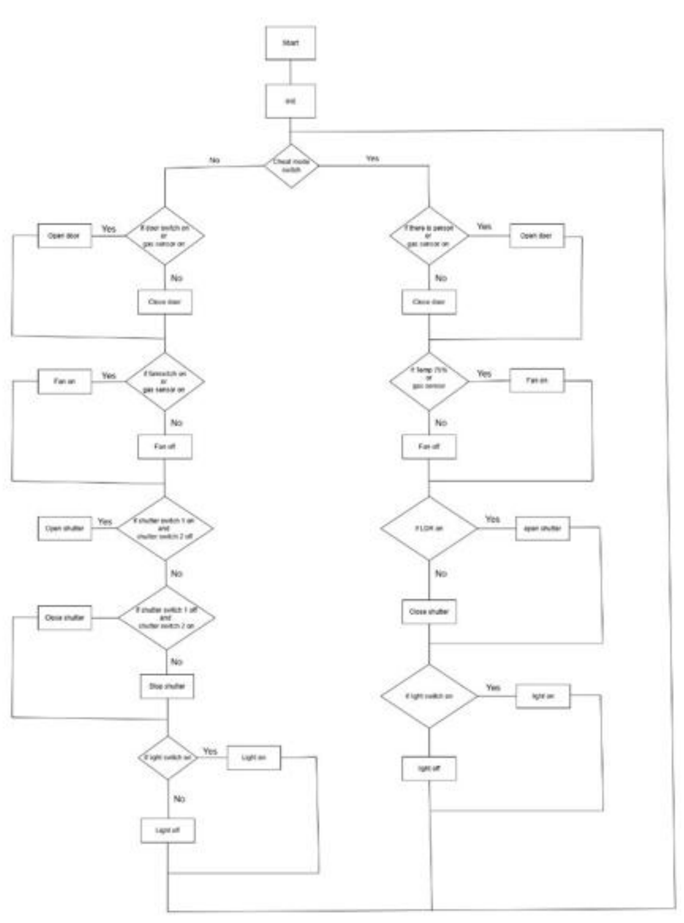
Introduction

Embedded systems are integrated computing systems consisting of hardware and software that can perform a specific task efficiently. They are used in automation, healthcare, and IoT, enhancing functionality and addressing challenges in the world. The PIC16F877A microcontroller works perfectly in these applications because it is cost-friendly and versatile, containing features such as analog to digital converters, timers, and serial communication interfaces. The PIC16F877A will be used in this project to develop a smart room system that automates common tasks, improves user comfort, and helps conserve energy. The system will utilize temperature, light, and ultrasonic sensors, as well as servo and DC motors enabling the automatic control of shutters, fans, and lights, so that they adapt to the environment. This project seeks to implement an embedded system for modern automation and to create an efficient living space that conserves energy.

Design

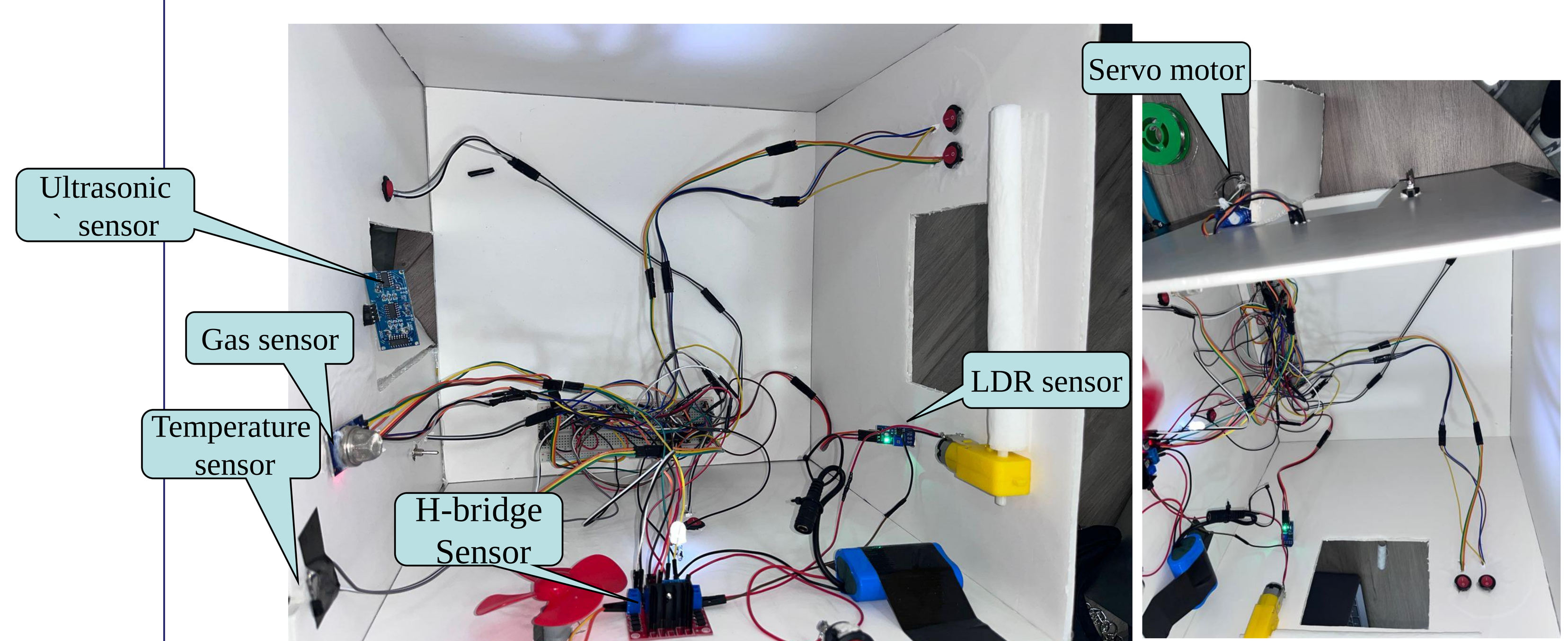
The schematic diagram of the Smart Room system with the PIC16F877A microcontroller is provided. The microcontroller has been interfaced with a set of devices including the ultrasonic sensor (HC-SR04) to sense presence, a daylight sensor based on an LDR to sense daylight, a room temperature sensor (LM35) to regulate room temperature, and a buzzer to give alarm. Door and fan movement is controlled by actuators like a servo motor and a DC motor. A crystal oscillator provides a stable timing. There are manual controls provided through the push buttons, and there is a DC-DC converter to supply 6V of regulated power. Connections are carefully brought to the corresponding I/O ports of the PIC to allow accurate real-time decision-making



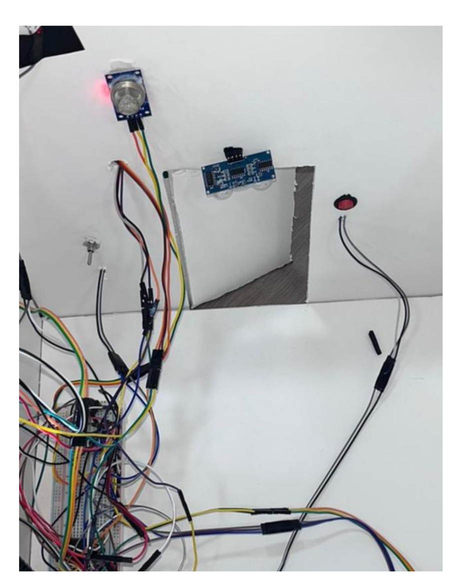
The flowchart represents the logic path of the Smart Room system, both normal operation and cheat (manual override) mode. Upon system startup, it checks the cheat mode switch. If enabled, manual logic is used, where the door can be opened/closed, fan turned on/off, or shutter and lights controlled by manual switches. If not cheat mode, the system uses sensor readings instead: the door is triggered by the presence of people to the ultrasonic sensor, the fan is turned on by the temperature sensor to see if there's too much heat, and the shutter's daylight control comes from the LDR. Each is also connected to a gas sensor to override in a case of a problem. The logical branching allows the system to look at environmental information and manual commands to make it comfortable and energy efficient

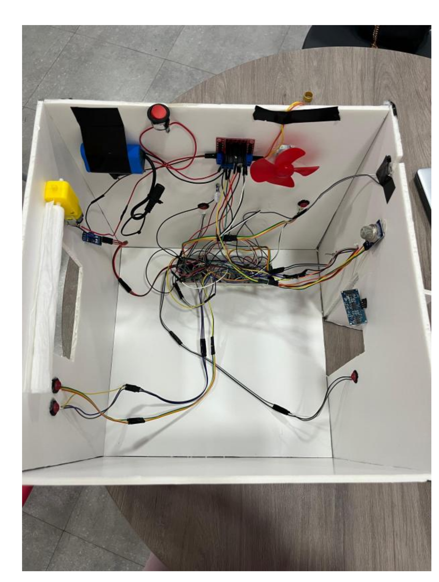
Results

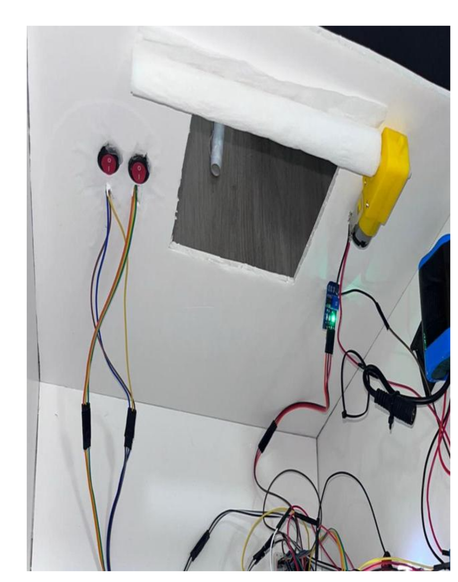
The key goal of this project energy efficiency, and user convenience through embedded system technology, the main objective of this project is to design and implement a smart room system that makes use of the PIC16F877A microcontroller to automate and remotely control various room functions, such as lighting, fan speed, door, and shutter operation, based on environmental conditions and user inputs.



Building from here, the labeled images give a clear visual reference to the system's most pivotal pieces of hardware. The ultrasonic sensor, mounted at the door entrance, enables door auto response, with the gas and temperature sensor boosting safety and comfort by triggering alarms or switching on the fan upon threshold breach. The H-bridge motor driver enables bidirectional control of the fan and shutters, directly interfaced with the microcontroller. The servo motor, positioned strategically above the cutout, opens the door mechanism smoothly, and the LDR sensor varies lighting or shutter control based on received ambient light. These work together to reflect a nicely integrated, responsive environment, demonstrating the power of embedded systems to precisely automate everyday chores







The extra photos further demonstrate the physical arrangement and internal cabling of the Smart Room prototype from various viewpoints. The first photo focuses on the location of the ultrasonic sensor, centrally fixed along the entry point to accurately sense motion, whereas the second photo displays a ceiling view of the core breadboard arrangement where the PIC16F877A microcontroller is positioned centrally with a high density of interconnections to sensors and actuators. The third photo displays how the top-mounted servo motor mechanism is used to achieve proper opening and closing actions, along with the override control-based LDR and manual buttons. These photos substantiate the real-world integration of the system, ensuring that each entity not just shares logical connectivity's in code but also lies in /its optimal place to function efficiently within a small, usable space.

Conclusion

The Smart Room project has successfully shown how to automate a house by combining efficiency with convenience and energy conservation using the PIC16F877A microcontroller. The advanced robotic system with environmental sensing, automation logic, and autopilot/manual toggling control caters to modern homes by making them more comfortable, secure, and energy efficient. The project does, however, experience some technical and mechanical problems, which with polished software engineering, smart part choices, and better design interfaces can be resolved. It demonstrates how embedded systems can enhance the intelligence and responsiveness of living spaces while laying the groundwork for more advanced smart homes.