# Smart Crib IoT

**Senior Design**

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## Background

The Smart Crib project integrates hardware and software components to provide users with a seamless and efficient smart home management solution. The system features smart lights, a smart door lock, and a smart fan, all of which can be controlled remotely through a user-friendly mobile application. The application serves as the central interface, allowing users to adjust light brightness, lock and unlock doors via a keypad or app controls, and set fan speeds. Communication between the app and devices is facilitated through an Azure Virtual Machine (VM) server, which processes HTTP control commands and maintains device statuses in real time.

The hardware layer includes an ESP32 microcontroller for the smart door lock & light and a Raspberry Pi Pico for the smart fan, enabling autonomous operations and network communication. The smart door lock features a keypad for local passcode input, providing an additional layer of security. The smart fan allows speed adjustments for customized comfort, while the smart lights support dynamic brightness levels for personalized lighting. By leveraging cloud-based infrastructure and efficient task management on microcontrollers, the Smart Crib project ensures reliable, responsive, and secure smart home control, blending convenience with cutting-edge IoT technology.

## Design Requirements

- **Seamless User Experience:** Create a unified platform for controlling multiple smart devices remotely, reducing the complexity of managing individual systems.
- **Scalability and Integration:** Design a modular system capable of integrating additional devices in the future without significant redesign.
- **Reliability:** Ensure robust and responsive communication between the cloud server and hardware devices to maintain consistent functionality.

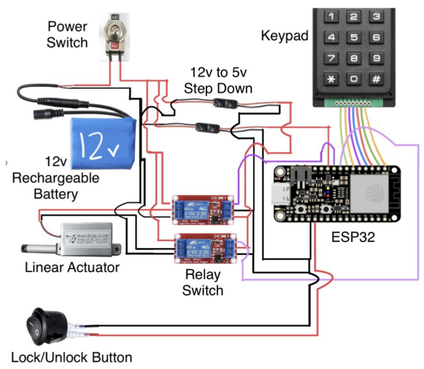


*Figure 5: Circuit Schematic for Smart Lock*

## Demos

*Figure 1: Smart Fan*

*Figure 2: Smart Door Lock*

*Figure 3: Smart Light OFF*

*Figure 4: Smart Light ON*

## System Design

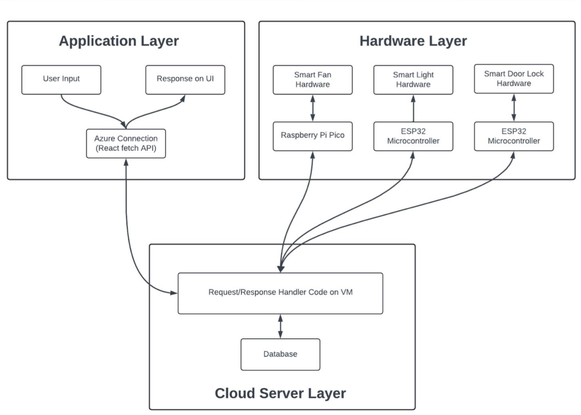


*Figure 5: System Architecture*

## Printed Circuit Board

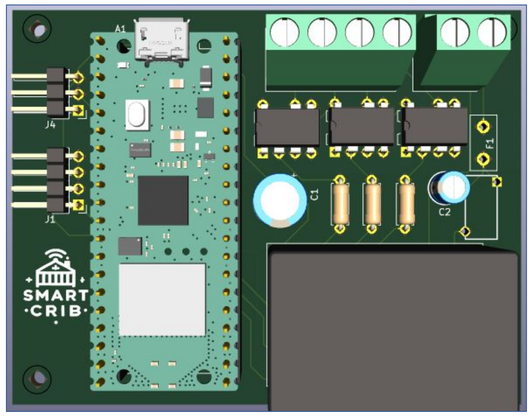


*Figure 6: Smart Fan PCB*

## Old Smart Fan Model

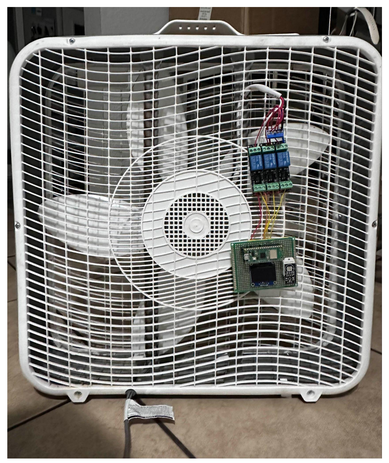

*Figure 7: Old Smart Fan Model*

## Conclusions and Future Work

The **Smart Crib project** successfully meets the client's goals by delivering an integrated, user-friendly system for managing smart lights, a smart door lock, and a smart fan. The mobile application provides seamless control, while the Azure Virtual Machine ensures real-time responsiveness, aligning with technical and performance specifications. Valuable lessons included the importance of robust cloud-device communication and balancing hardware constraints with scalability. Future plans involve expanding device support, integrating predictive automation, and enhancing security, with gratitude extended to the client, sponsors, and open-source contributors for their support.

## References

1. Johnson, M. T., and Zhang, H., "Optimizing IoT Device Communication for Smart Home Applications," IEEE Transactions on Internet of Things, 2021, Vol 8, pp 1457-1468.
2. Gupta, R., and Singh, A., "Energy-Efficient Lighting Solutions for Smart Homes," International Journal of Smart Systems and Technologies, 2020, Vol 12, pp 89-103.
3. Brown, C., and Miller, J., "Enhancing Security in Smart Locks: A Comprehensive Review," Journal of Computer Science and Information Security, 2019, Vol 15, pp 45-56.
4. Smith, L., and Davis, R., "Cloud-Based Control Systems for IoT Applications," ASME Journal of Computing and Information Science in Engineering, 2022, Vol 22, pp 112-120.
5. Patel, V., and Kumar, N., "Integration of ESP32 Microcontrollers in IoT Systems," IEEE Internet of Things Journal, 2021, Vol 7, pp 3342-3350.