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Product Pitch

Automated CardEaler is a **real-time computer-vision-powered** system that fully automates the dealer's role in Texas Hold'em, eliminating the need for a human dealer. The system's functionalities include dealing cards, detecting and tracking cards currently being played, and detecting user's moves (Check, Fold, Raise, Call). With these, ACE allows at most 4 players to enjoy playing Texas Hold'em among themselves without missing out anyone.

The most critical requirements for this system were **card classification accuracy**, **dispensing accuracy**, and **input detection accuracy**.

Our unit tests revealed that all 52 cards are correctly classified with 100% accuracy with an average of 95% confidence, dispensing achieved suboptimal accuracy of ~87%, and input detection accuracy of 100% for tap detection accuracy and 84.5% for weight sensing accuracy. These results effectively endorse the critical requirements we prioritized to achieve.

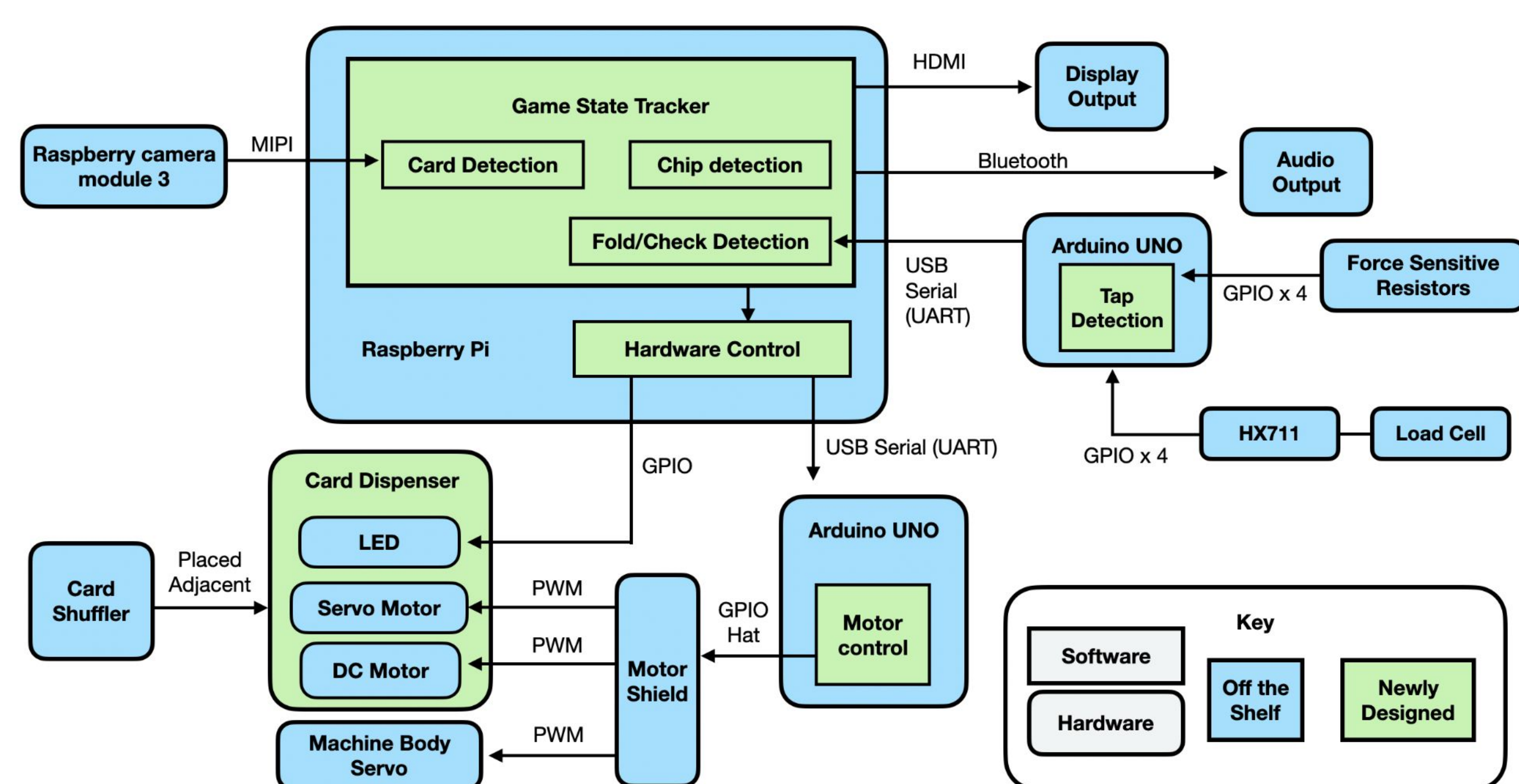
System Architecture

The RPI acts as the brain of the system. It receives inputs from the players through various sensors to determine the game state. It then sends commands to the hardware controlling arduino to control the machine.

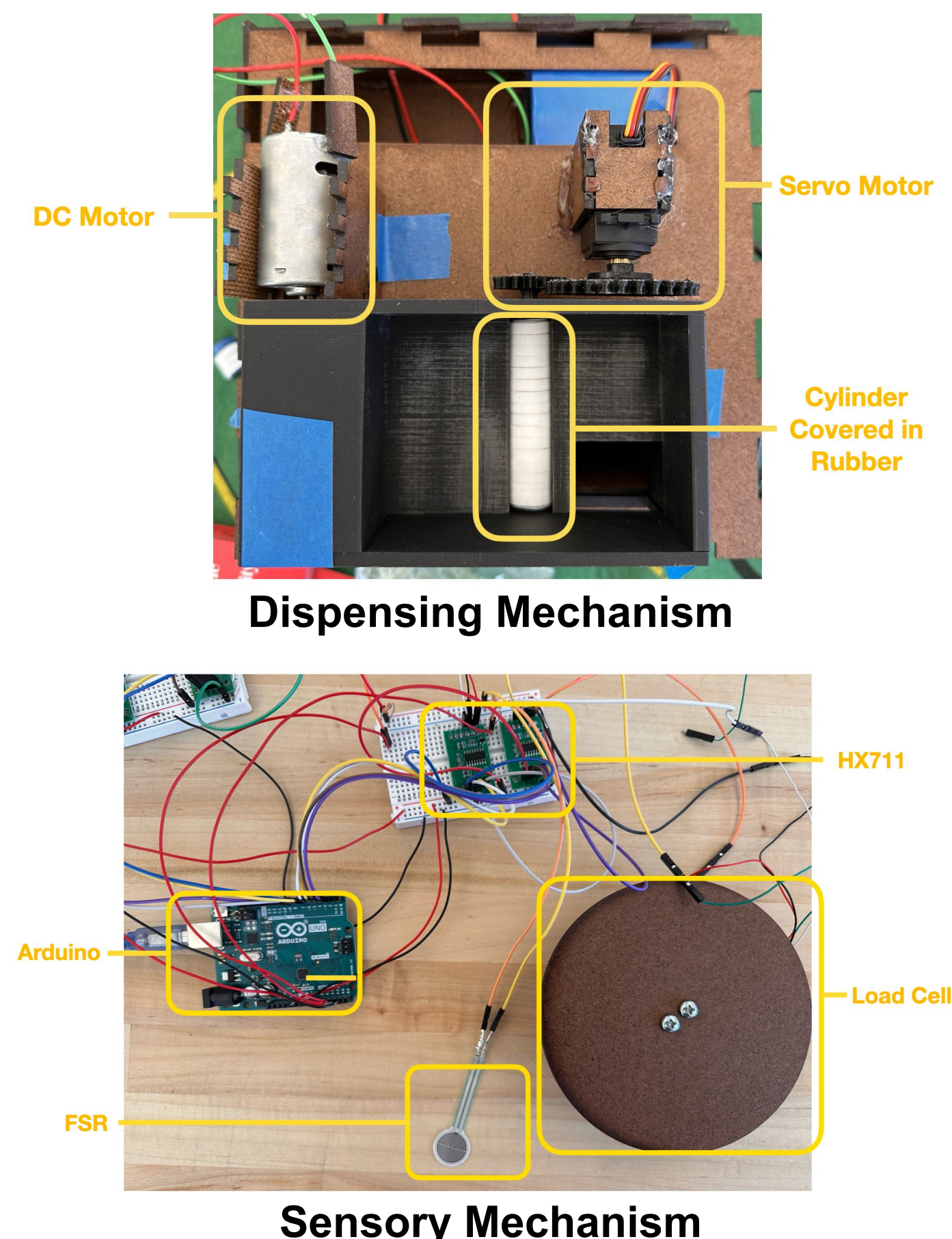
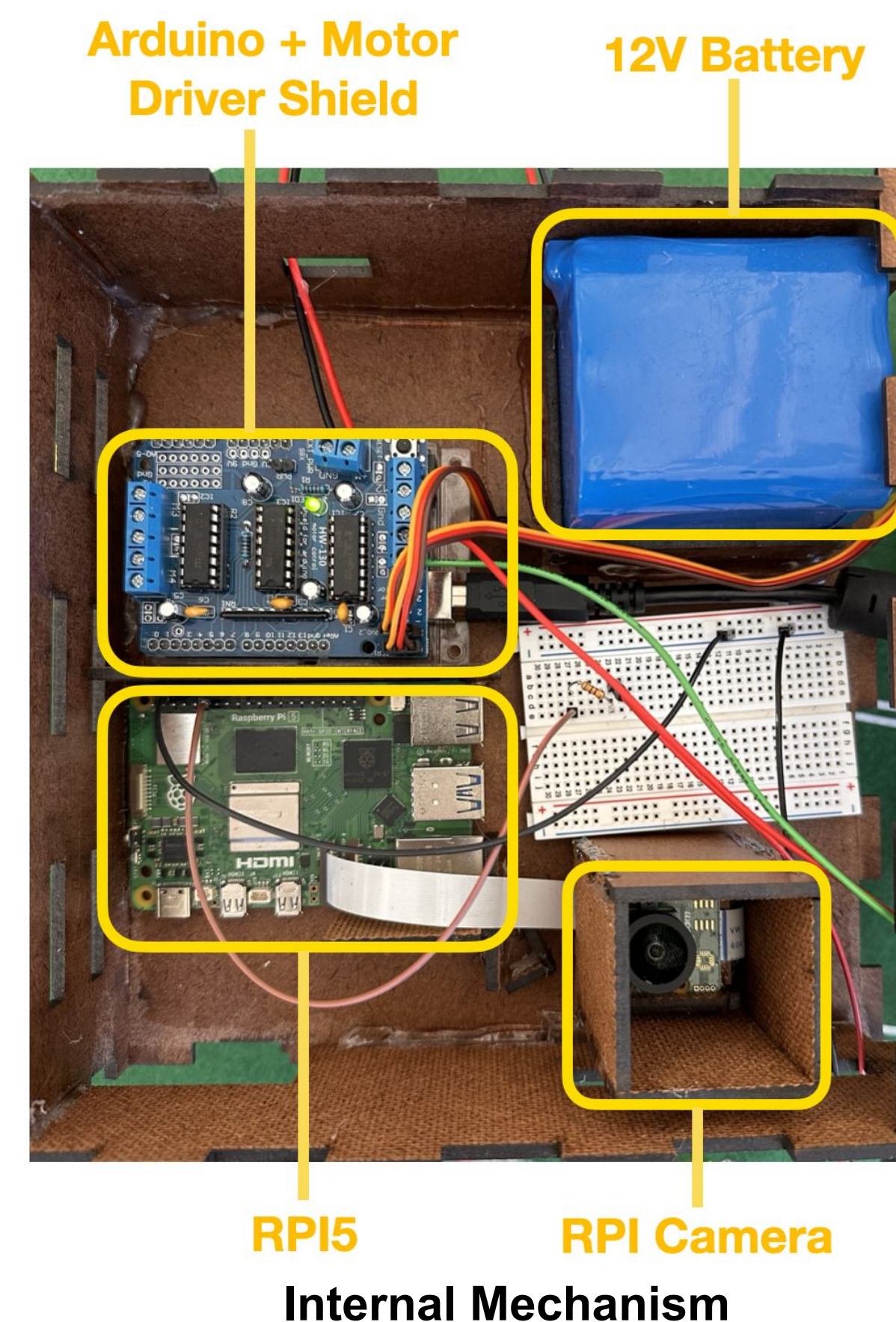
A camera is used to run the card detection module, which detects the card that is about to be dispensed. This information is saved and used in the final stage.

Inputs sensors are all connected to the sensor arduino, which is connected to the RPI via USB serial port. The serial signals are parsed and used in the Game State Tracker.

Two source of outputs: audio and visual.



System Description

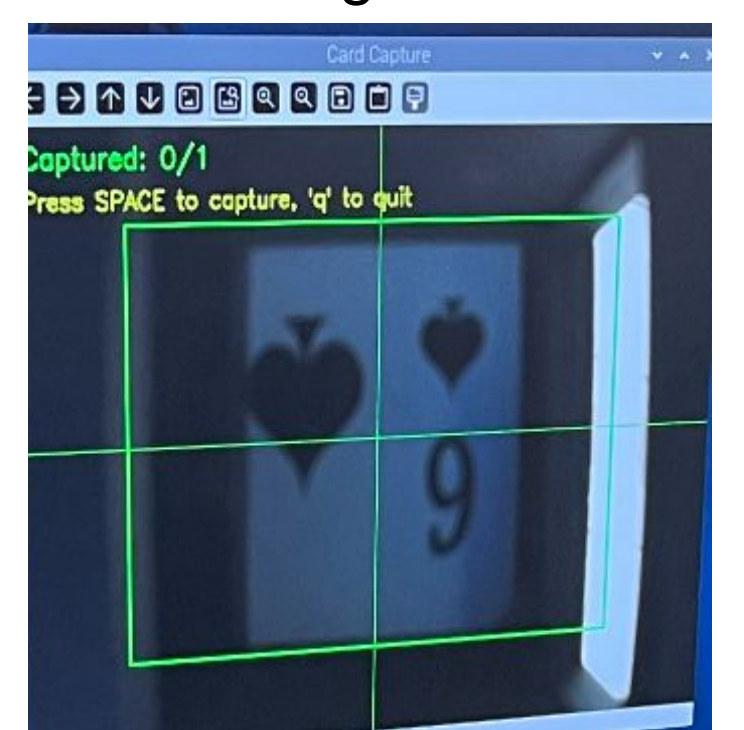


Hardware

- Machine body
- Dispenser
 - Dc Motor
 - Servo
- Raspberry Pi 5
- Arduino Uno + Motor Driver Shield
- Force Sensitive Resistor
- Load Cell + HX711 amplifier
- RPI Camera Module

Computer Vision

We collected our own data in the exactly same setting as the production environment. For the purpose of this project, we intended the model to achieve overfitting to our deck of cards, which will be provided to the players. We made the model perform transfer learning on the MobileNet V3 Large model, equipped with the capability of detecting features.



System Evaluation

Metric	Target	Actual
Size Constraint	Within 20.3 cm x 20.3 cm	20 cm x 20 cm
Rotation Latency	< 1500ms	≈ 1000 ms
Rotation Accuracy	Within $\pm 1.5^\circ$	$\pm 0.1^\circ$
Dispensing accuracy	90%	87%
Card detection latency	< 500 ms	Instant (< 1 ms)
Card detection Accuracy	> 99%	100%
Chip counting Accuracy	100%	84.5%
Double Tap detection accuracy	100%	87% (Only FN for error)
Press and Hold detection accuracy	100%	100%

Table 1: Test Result

Choice	Reasoning
Accuracy over Latency	Increased time given for each dispense sequence to make the machine become stable for each card throw.
Power over Weight	Equipped the machine with a battery that has greater power for stronger voltage/current for our DC motor.
Space over Aesthetics	Removed a wall to provide more space for the wires.
Performance over Generalization	Our card detection model is overfitted on only our cards. Less general, but more accurate.

Table 2: Trade offs

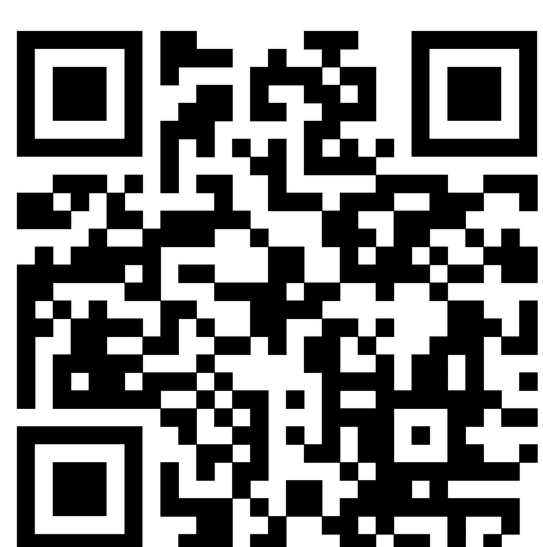
Conclusions & Additional Information

Overall Assessment:

Despite the huge volume of the project, our team was able to build all the necessary components and integrated them to work together. Although our dispenser accuracy and chip counting accuracy falls a little behind our goal, ACE meets the minimum requirements to provide an automated Poker gameplay experience.

Lessons Learned:

Many trials and prototypes are inevitably created during a project. If we were to do it over again, we would reduce the number of trials by reasoning and planning more thoroughly on purchases and design decisions during the early stages of the project.



<https://course.ece.cmu.edu/~ece500/projects/s25-teama2/>