DuelReality

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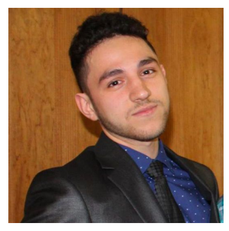


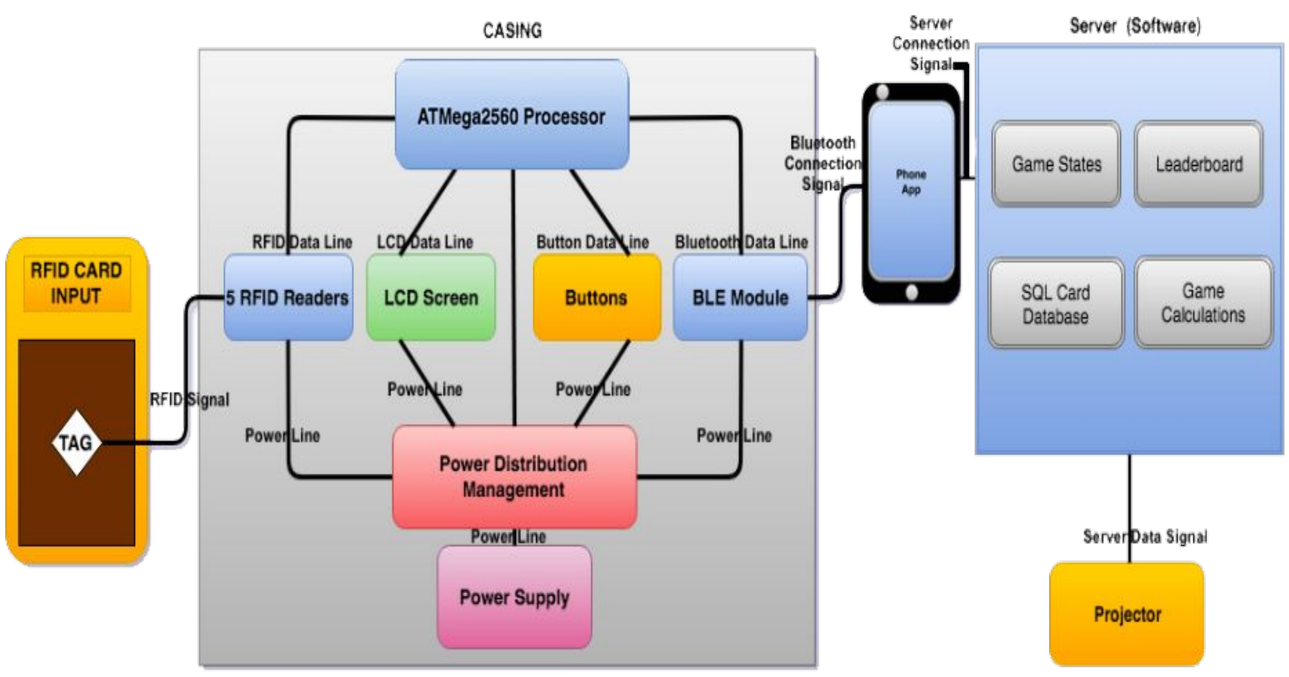

Abstract

DuelReality is a gaming system aiming to change traditional user experience by combining virtual reality and physical reality into one. Implementing the Yu-Gi-Oh! Trading Card Game - gaming model, a two player game is setup with each player wearing the wristband device as the physical support for the gaming system. Each wristband device contains 5 RFID readers in order to read IDs of cards equipped with RFID tags, and a Bluetooth module to communicate with a user's smartphone all being handled by an internal processor. A phone app serves as the midway connection between the wristband device and a web server that hosts the game model and performs any required calculations.

System Overview

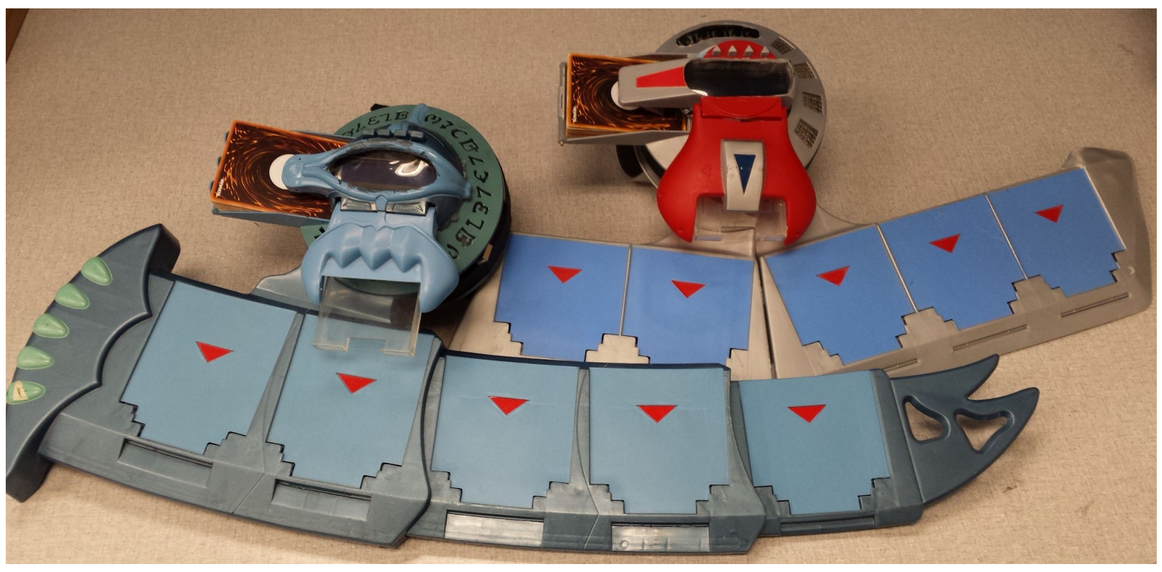
DuelReality system uses RFID technology to read the attributes of playable cards. Each card is embedded with an RFID tag that is registered on a dedicated server database. The data received when a user taps a card on an RFID reader location or the action of making an attack is sent to a microprocessor which then pushes the command to a smartphone app through a Bluetooth module. The smartphone app ultimately sends the commands to the server that runs the game algorithm; and pushes updated messages to all clients and spectators while displaying the current game condition of each player. Our system is coded in Java, C, and C#.

Block Diagram



Results

- System allows user recognition and connection between two Bluetooth-enabled devices to a dedicated server
- PCB design integrates an ATMega2560 Processor.
- Game actions are projected into a user's Field-Of-View through Hololens.
- Capability to start, play, and end a fully functional game between two systems.



Specifications

Specification	Goal	Actual
Rich Gaming Experience	Minimum of 20 cards required in each player's deck, game between 2 player	200 cards registered in server database for each player. Support 2 player duel.
Lightweight Product	The wristband device should be light enough to wear and hold still during game play.	Per device weight less than 1.0kg (2.2 pounds).
Wide User Base and Affordability	Device should meet child safety standard and the cost for each device under mass production should be less than $80	The device meet safety standard and per device cost under mass production is less than $60
Sufficient battery life	Battery life greater than 4 hours	Actual battery life greater than 5 hours under peak power dissipation

Acknowledgement

Team DuelReality would like to thank Professor Robert Jackson for his continued support and advice regarding our project. We would also like to thank our evaluators, Professor Qiangfei Xia, Professor Christopher Hollot, and Professor Aura Ganz for their constructive feedback. Finally, we would like to thank Jeremy Paradie and Shira Epstein for their continued assistance and support.

Mobile Interface

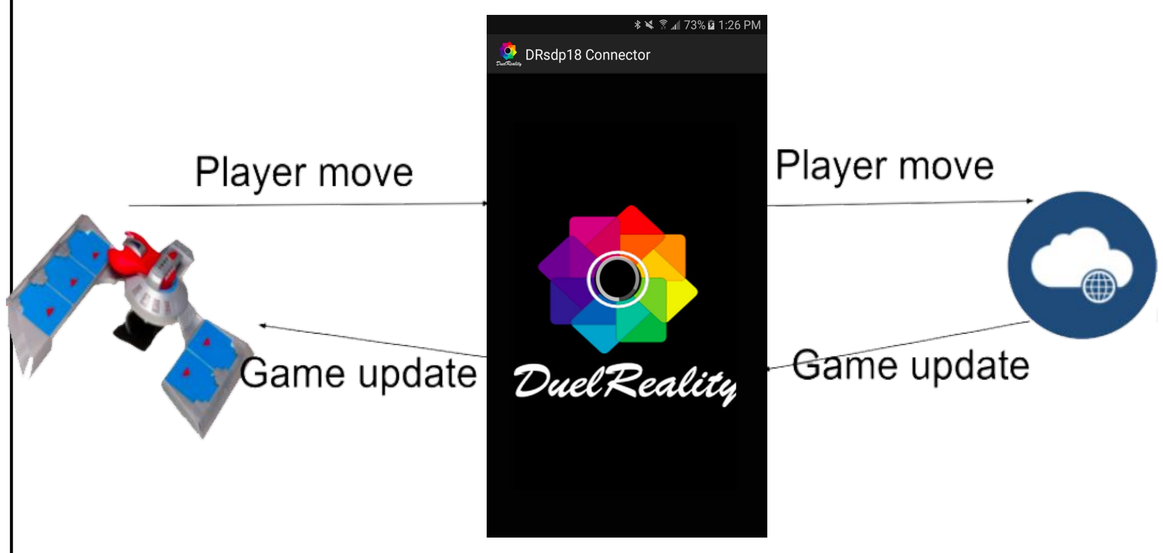


Figure 1. Phone app connecting wristband and server

Our app receives the card IDs and actions sent through Bluetooth from the microprocessor and pushes this data to our server. To develop this app, we used Android Studio as the development environment and programmed in Java.

Device Communication

The use of Bluetooth as a midway connection between our wristband device and our phone app combined with the low data rate from a user's phone to a server ensures the mobility and low cost of a DuelReality system. People can play anytime and anywhere where their phone can connect to a network.

Hardware Components

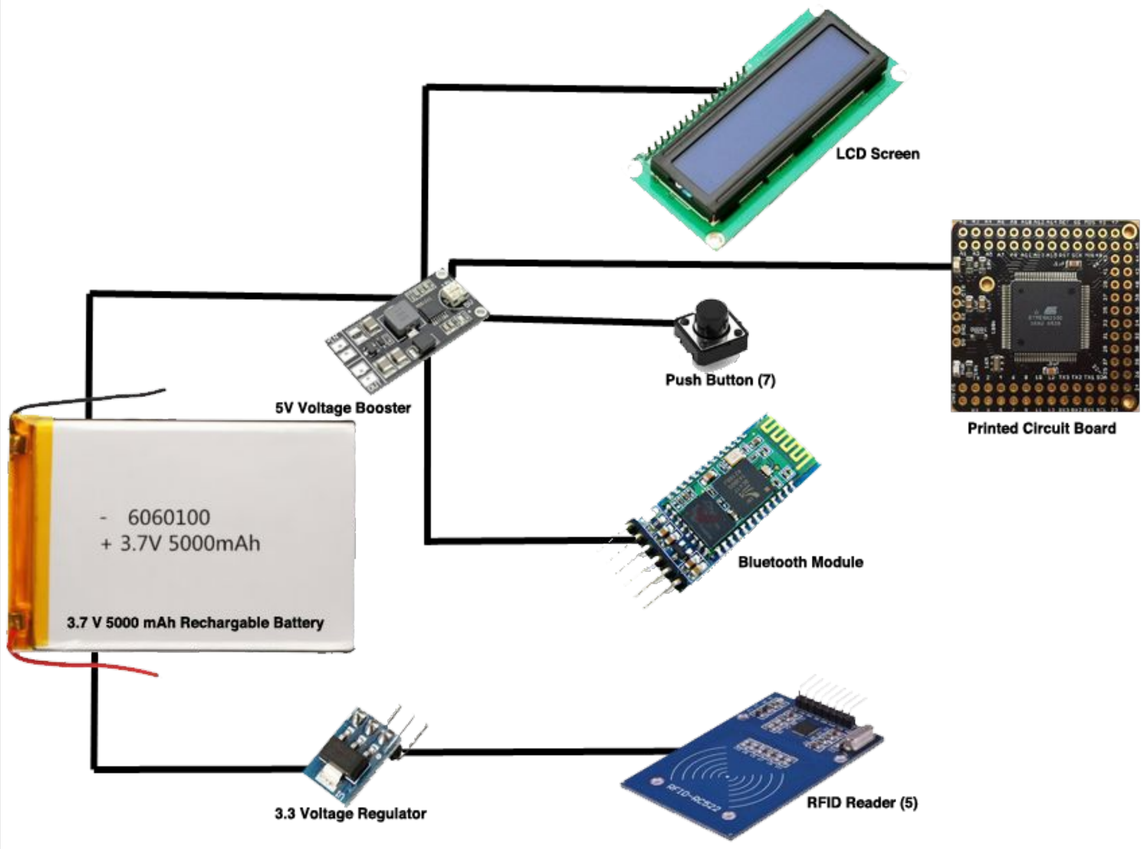


Figure 2. System Components

Power Supply

Our DuelReality system requires a 5V power supply for the PCB, Bluetooth module, LCD screen, and buttons; as well as a 3.3V power source for the RFID readers. Our Power Source is a 3.7V Lithium rechargeable battery, whose voltage is raised to 5V by a voltage booster to supply most of the components, and converted to 3.3V by a voltage regulator for our readers.

Server

Our server is hosted on a secure Google Cloud Machine that handles all calculations, databases, and game states. The server receives commands from users and pushes messages to all clients and spectators. Through Google, we are able to host thousands of matches simultaneously.

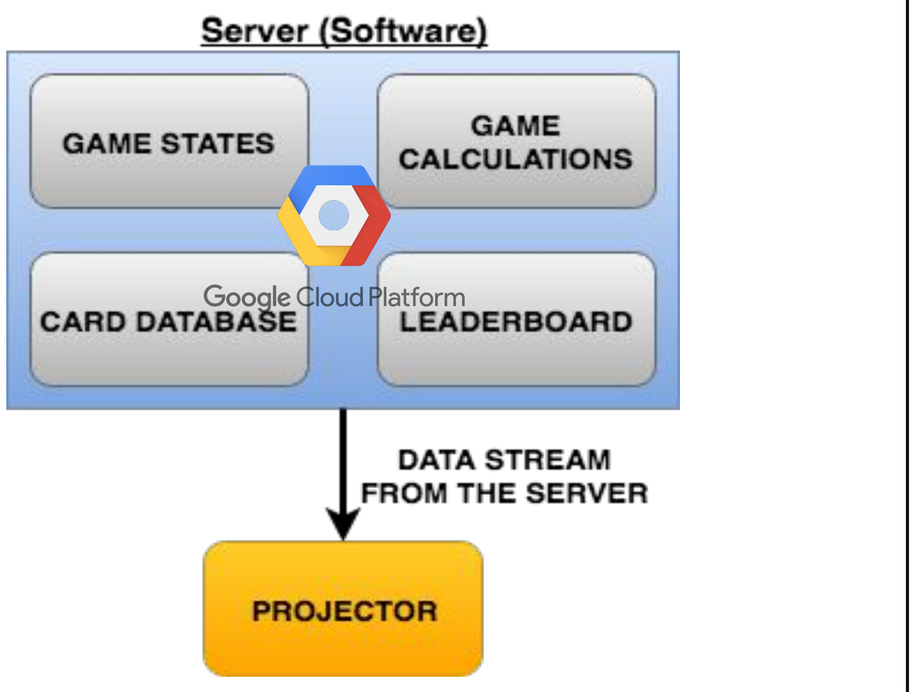


Figure 3. Server hosting game calculations, databases, and game states.

Display

Figure 4. Hololens View

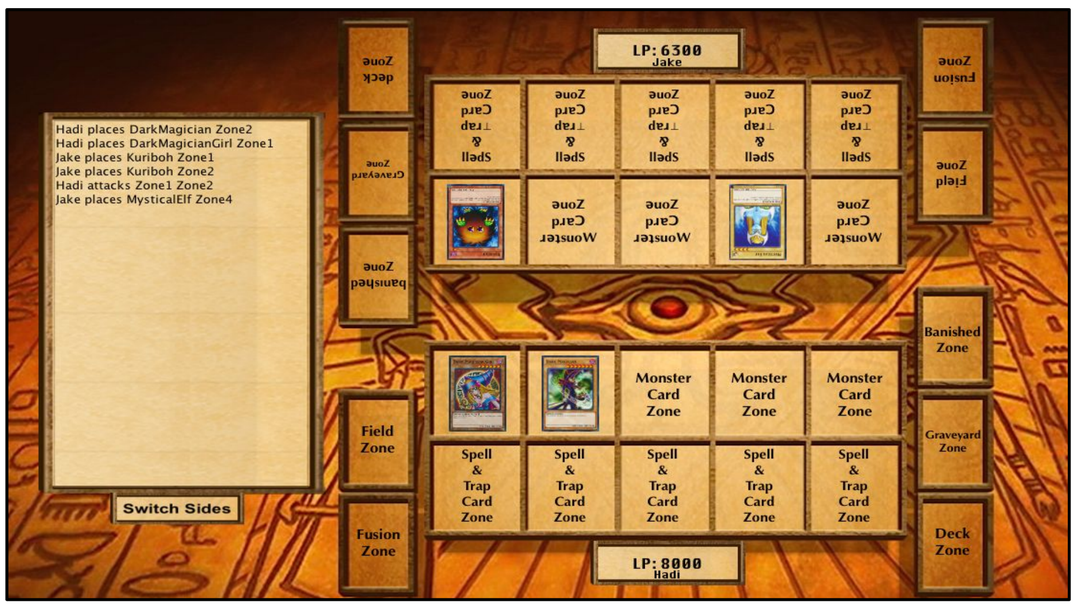


Figure 5. Spectator screen

Cost

ITEM	QTY	Unit Price for development	Unit Price for Production
RFID Reader	10	$8	$2
RFID Card	40	$0.50	$0.40
LCD Screen	2	$6	$4
Bluetooth module	2	$6	$3
Buttons	14	$0.20	$0.10
PCB	2	$20	$8
Plastic casing	2	$20	$16
Power supply system	2	$10	$7
Per device	2	$113	$57
Total (2 device)		$227	$113