

Project 2: "Bulls and Cows" Game Controller

- Rule of the game
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- Keypad
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Rule of the game

- Bulls and cows is a number guessing game.
- When game begins, a secret number is given:
 - Example: 1234 (digits cannot be identical)
- Player guesses a number each round and gets feedback:
 - Example: player guesses 7253 (digits cannot be identical), gets feedback "1A1B"
 - "A" means both digit and position is correct, "B" means digit is correct but the position is wrong.
- If player gets a "4A0B" within 8 rounds, player wins the game

Project 2 Content

- Goals of this project:
 - Learn how to use keypad
 - Learn the concept of interrupt
 - Learn how to use Change_Notice interrupt
- Minimal Hardware:
 - PmodKYPD, PmodSSD*3, Pmod8LD, wire
- Inputs:
 - PmodKYPD, 14 keys will be used.
- Outputs:
 - PmodSSDs, Pmod8LD, on-board LEDs.

Controller Functions

Five modes:

- Mode1 - Initial:
 - The secret number is generated.
- Mode2 - Guessing
 - Player input his/her guessed number via keypad.
- Mode3 - Result
 - Player gets the feedback of the guessed number in this round.
- Mode4 - History
 - Player can review the game history of last round and before.
- Mode5 - Finishing
 - The final result is displayed. The secret number is shown, and will be flashing if player wins the game.

Keypad functions

Modes	0-9	C	D	E	F
Initial	--	--	Play with given number	Play with random number	--
Guessing	Input digit	Clear	Delete	Enter	History
Result	--	--	--	Continue to next round	History
History	--	UP	Down	--	Resume
Finishing	--	--	--	Reset	--

Output functions

Modes	PmodSSDs 1&2	PmodSSD 3	On-board LEDs	Pmod8LD
Initial	--	--	0001	All ON
Guessing	Number being guessed	--	0010	Current round
Result	Number being guessed	Result of this round	0100	Current round
History	Guessed number of the round under review	Result of the round under review	0110	Round under review
Finishing	Correct number Flashing if player wins	--	1000	Flashing if player wins

Controller Functions (detailed)

Initial Mode

- Round is set to 0, all history data is clear.
- Pressing "D" will go to Mode 2 with the secret number predefined by yourself
- Pressing "E" will go to Mode 2 with a randomly generated secret number

Controller Functions (detailed)

Guessing Mode

- **Input Digit buttons** –
 - When a number button is pressed, the current displayed number will shift one digit to the left and the just entered number will be displayed at the least significant digit position.
 - For example, pressing "3" will cause the current displayed number "12" to become "123".
 - When there are already 4 digits entered, pressing number buttons will be ignored.
 - Pressing a digit button which is identical to any digit that has already been entered will be ignored.

Controller Functions (detailed)

Guessing Mode (cont.)

- **Delete button** –
 - Delete the least significant digit, while the remaining digits (if any) shift one digit to the right to replace the deleted one.
 - If all the entered digits are deleted, nothing will be displayed.
- **Clear button** – clear all the entered digits.
- **Enter button** –
 - If less than 4 digits have been entered, pressing enter button should be ignored. Otherwise, round is increased by 1, go to Mode 3.
- **History button** –
 - If any previous round has been played, go to Mode 4. Otherwise, ignore this button.

Controller Functions (detailed)

Result Mode

- Result of current round is display on the SSD3. The first digit represents how many "A"s there are while the second represents how many "B"s there are. Guessed number of current round is kept displaying on SSD 1&2.
- **History button** –
 - If any previous round has been played, go to Mode 4. Otherwise, ignore this button.
- **Continue button** –
 - If current round is already the 8th, or the current result is "40" (means 4A0b), go to Mode 5. Otherwise, go to Mode 2.

Controller Functions (detailed)

History Mode

- Initially the guessed number and the result of the last round are under review.
- **Up & Down buttons** – change the round under review and rotate.
- **Resume button** – go back to the Mode where you pressed History (Mode 2 or 3).

Finishing Mode

- **Reset button** – go to Mode 1.

Keypad

The keypad looks like this:



- 12 pins total, 4 rows, 4 columns, 2VCC and 2GND

Pin	1	2	3	4	5	6	7	8	9	10	11	12
Signal	COL4	COL3	COL2	COL1	GND	VCC	ROW4	ROW3	ROW2	ROW1	GND	VCC