STAMP FOUR

CONNECT 4 WITH THE BASIC STAMP

ME-GY 5643 MECHATRONICS

FALL 2015 TERM PROJECT

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OVERVIEW

- Scope
- Design
  - Connect Four Frame
  - Feeder System
    - Ultrasonic Sensor
    - Servos
  - Remote Controller
    - Accelerometer
    - Limit Switch
- Software
  - User interface
  - Artificial Intelligence
- Production
  - Bill of Materials
  - Cost Analysis
- Demonstration
- Questions

SCOPE

- The purpose of this project is to have a connect 4 board that can interact with a person.
  - It has to be able to take in a player's move
  - It has to be able to decide on intelligent moves
  - It has to be able to place the players piece in the correct column
  - It has to be able to decide if someone has won
  - It has to follow the rules of connect 4

DESIGN I: CONNECT FOUR FRAME

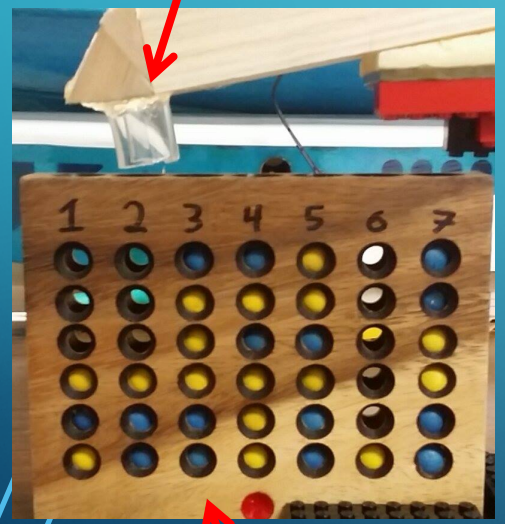
- For this, we used a ramp that took in the ball and placed it into the correct column of the board.
- The ramp is connected to a continuous servo that rotates a gear moving the ramp back and forth.
- An ultrasonic PING sensor and a backstop on the ramp are used to give feedback of the ramp's position to the microcontroller.

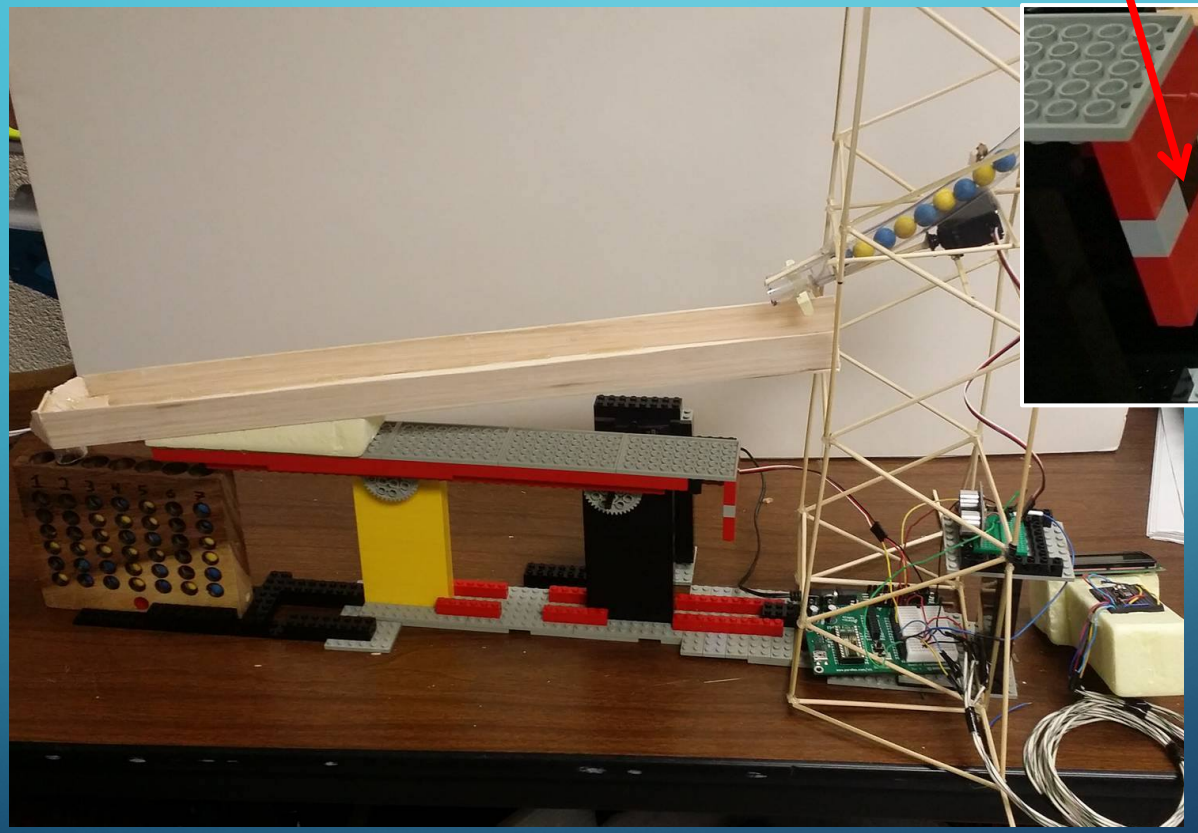
CONNECT FOUR FRAME

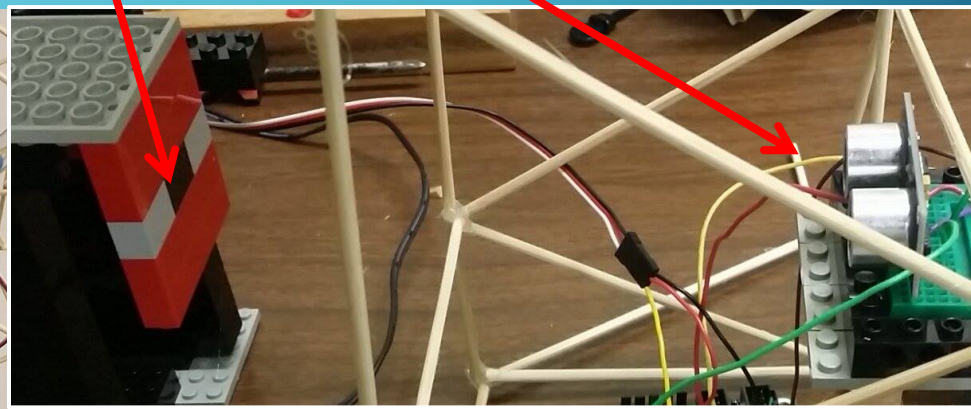
End of Ramp

Blocker

PING sensor



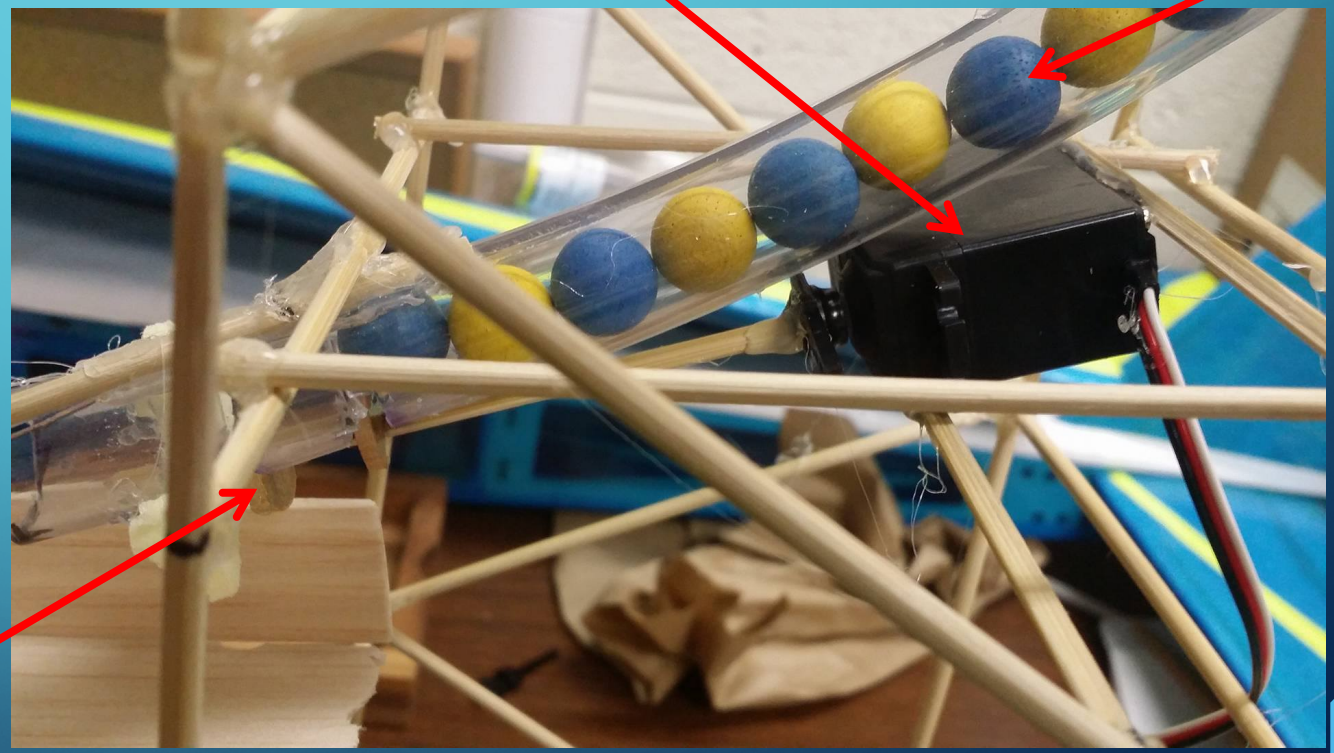




Connect 4 Board

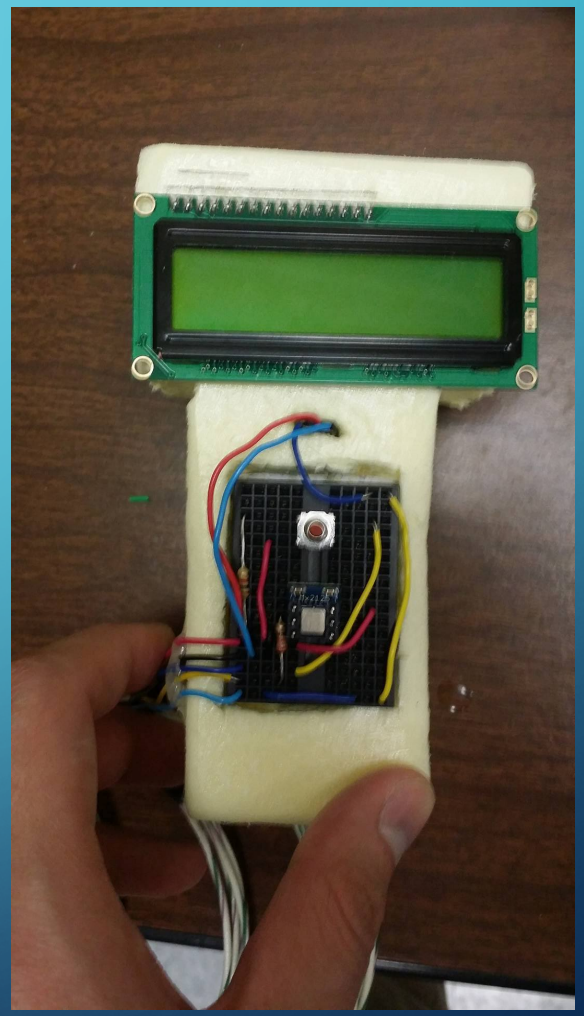
DESIGN II: FEEDER SYSTEM

- Feeder System
  - A standard servo
    - connected to a wooden shaft that that two blockers rotated 180° of each other.
    - Releases one ball for each move

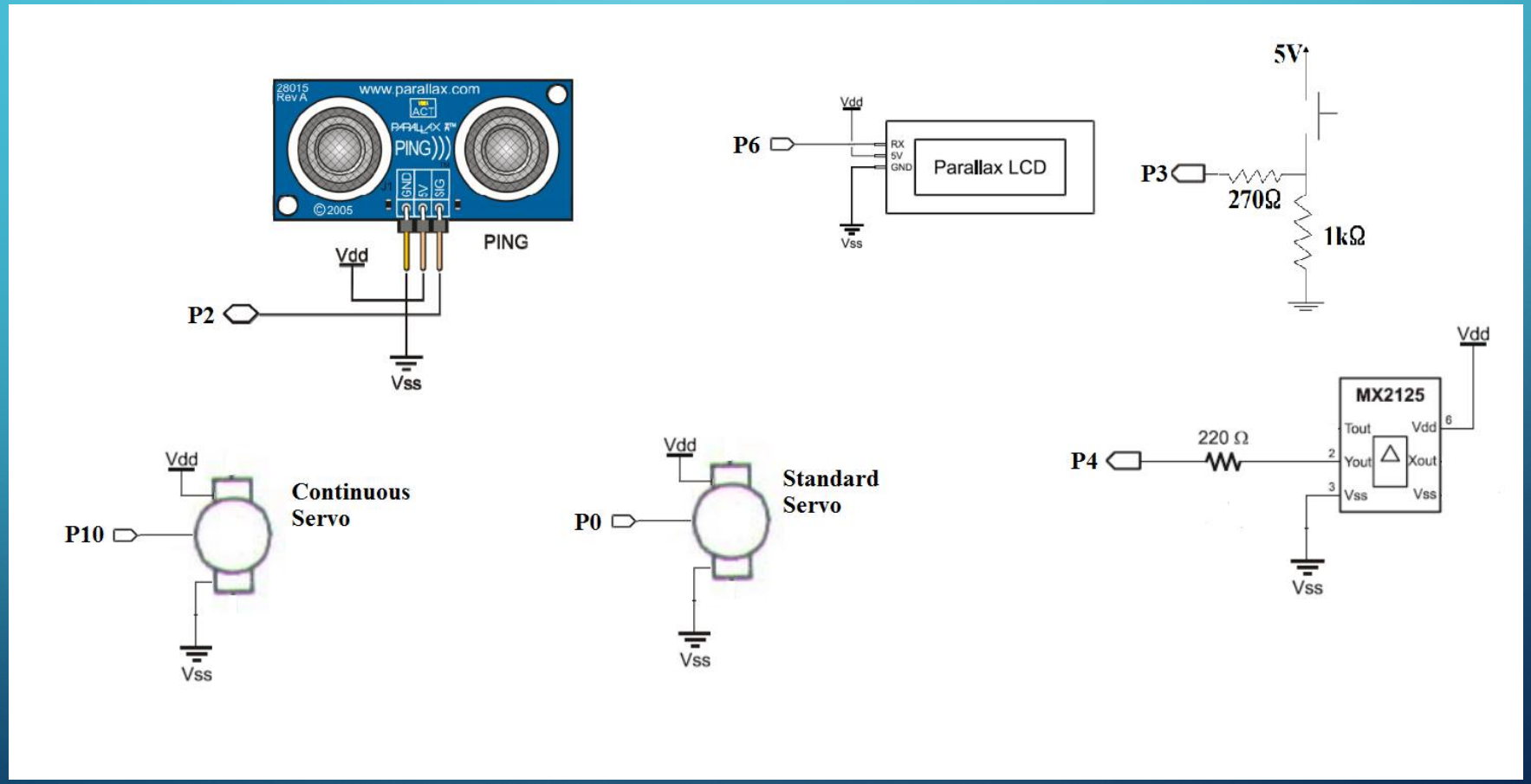


USER INTERFACE HARDWARE

- Remote Controller
  - Liquid Crystal Display
    - Provides the user feedback of accelerometer
    - Displays which player's turn it is
    - Status of the game
  - Mesmic 2125 2 axis accelerometer
    - Allows the user to choose a value from 0 to 6, 7 numbers, which represents the desired column
  - Limit switch
    - Allows the user to confirm the value



CIRCUITRY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P3
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Vdd
P10
Continuous
Servo
Vss
Vdd
P0
Standard
Servo
Vss
P4
220 Ω
MX2125
Tout
Vdd
Yout
Xout
Vss
Vss
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Vss

SOFTWARE I: USER INTERFACE

```
SEROUT 6, 84, [" Player's turn.",13," Column: "]
PAUSE 20
DO
 PULSIN 4, 1, x
 nextmove=(x-1875)**320
 SEROUT 6, 84, [158, DEC (nextmove+1)," "]
 PAUSE 50
 IF IN3=1 THEN
  IF(cols(nextmove)<6) THEN backmain
 ENDIF
LOOP
```

Takes in the accelerometer range from 1875 to 3125 and transforms it into a range of 0 to 6.

If the button is pressed and the column selected is not full, then store the move and continue.

SOFTWARE II: ARTIFICIAL INTELLIGENCE

- The Basic Stamp assigns and stored values for each space available on the Board.

- The Basic Stamp runs through 4 Steps to compute the column it will place its next piece into.

LABELING AND STORAGE OF EACH SPACE

The Basic Stamp saves two arrays of 42 Bits.

The first array stores whether or not a piece in the allocated cell.

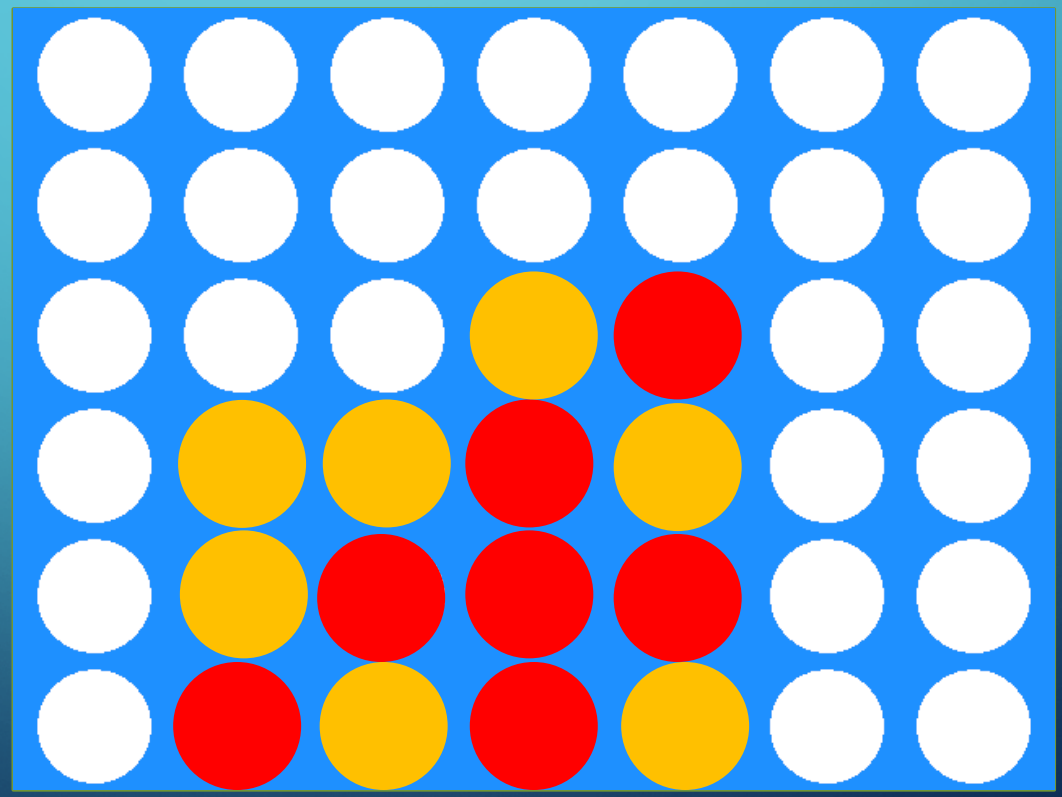
The second array stores which player's piece it is.

AI
STEP 1
CAN THE COMPUTER WIN THIS TURN

If it can win, then it will move in that column to win the game.

Computer

Player

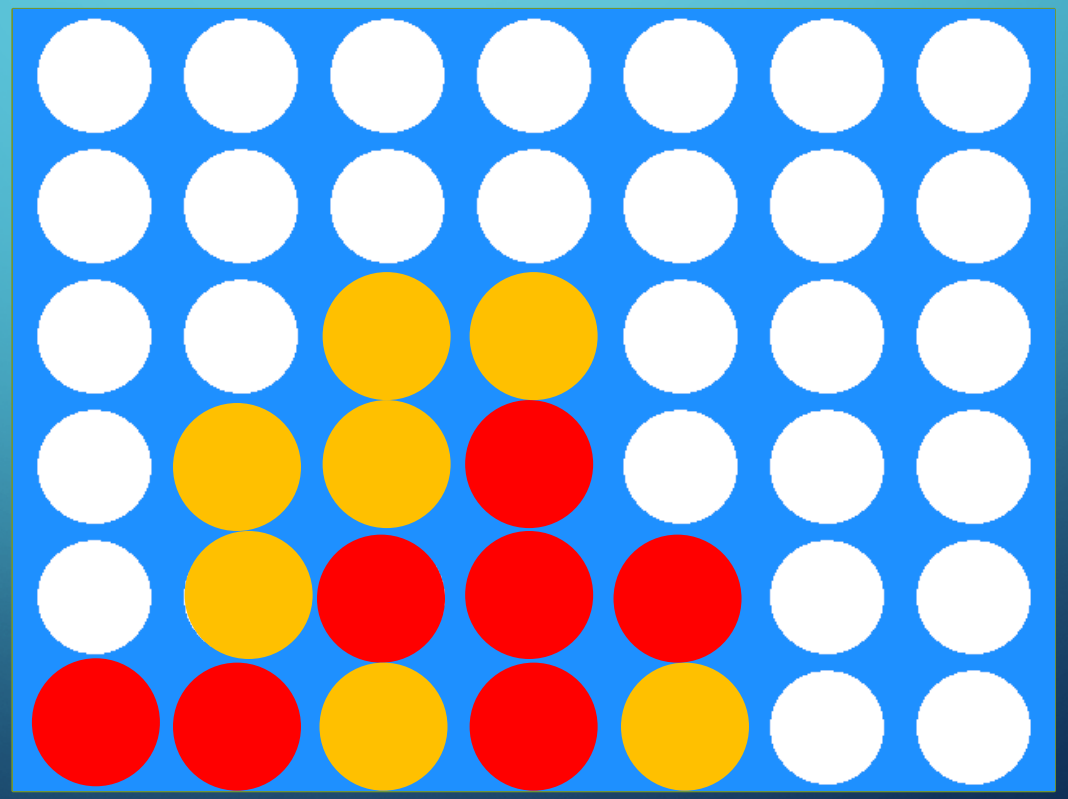


STEP 2
CAN THE PLAYER WIN THIS TURN

If the player can, then it will move in that column to prevent the win.

Computer

Player

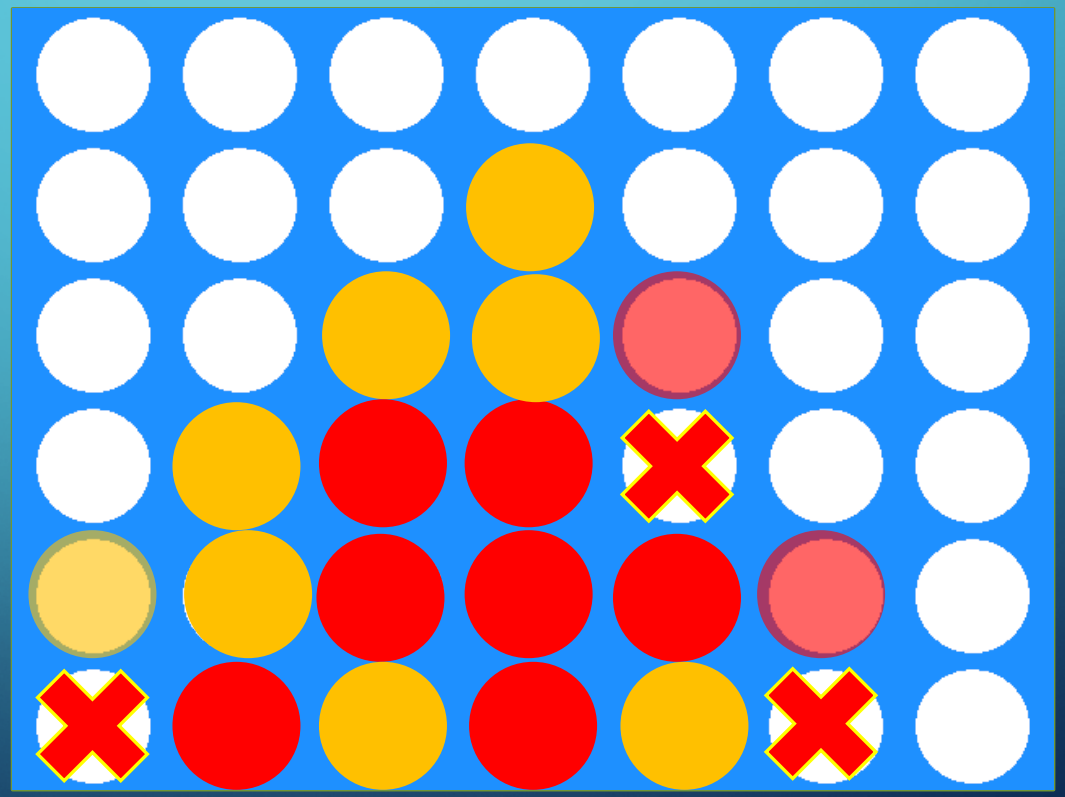


STEP 3
DOES A WIN BECOME OPEN AFTER THIS MOVE

If it does, then it will not move in that column to prevent the player's win or a block.

Computer

Player

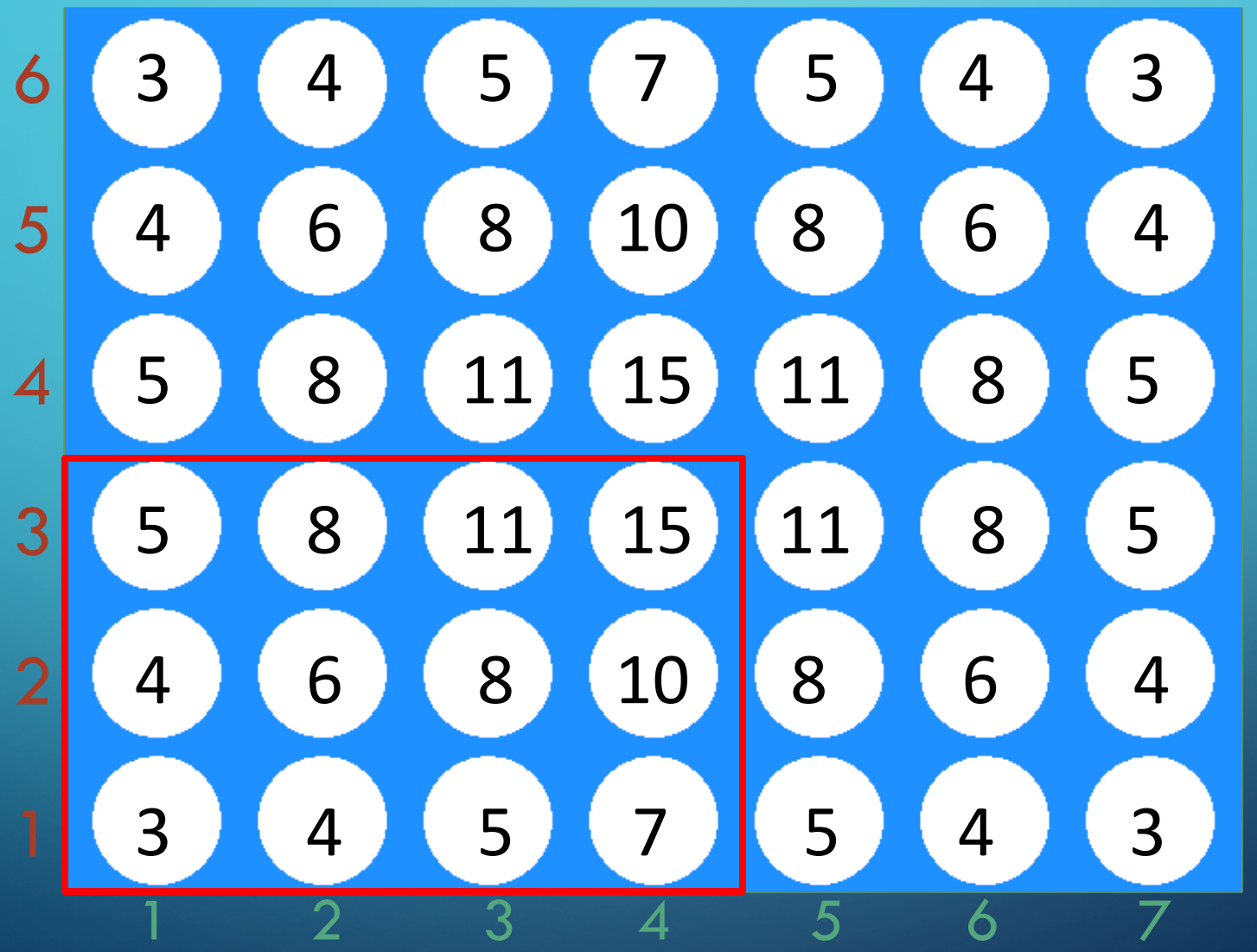


STEP 4
MOVE IN THE SPACE WITH THE HIGHEST NUMBER OF WIN COMBINATIONS

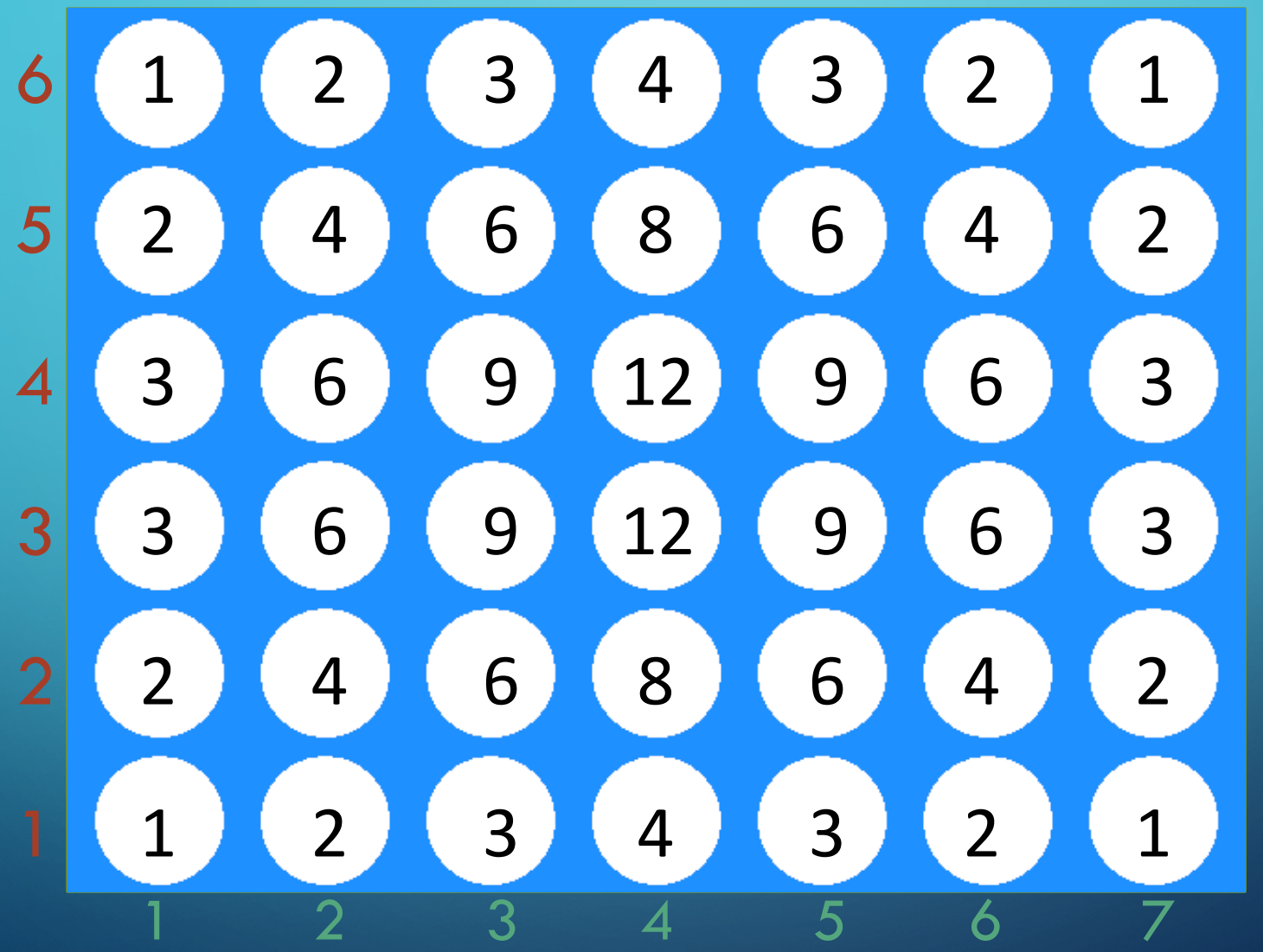
To start doing this, a board of the combinations has to made and implemented into the Basic Stamp.

Then a ranking system will pick the highest combination count of all remaining columns and place a piece there.

Number of win combinations



Modified number of win combinations



Equation Used

If column #>4 Then
column #=8-column #

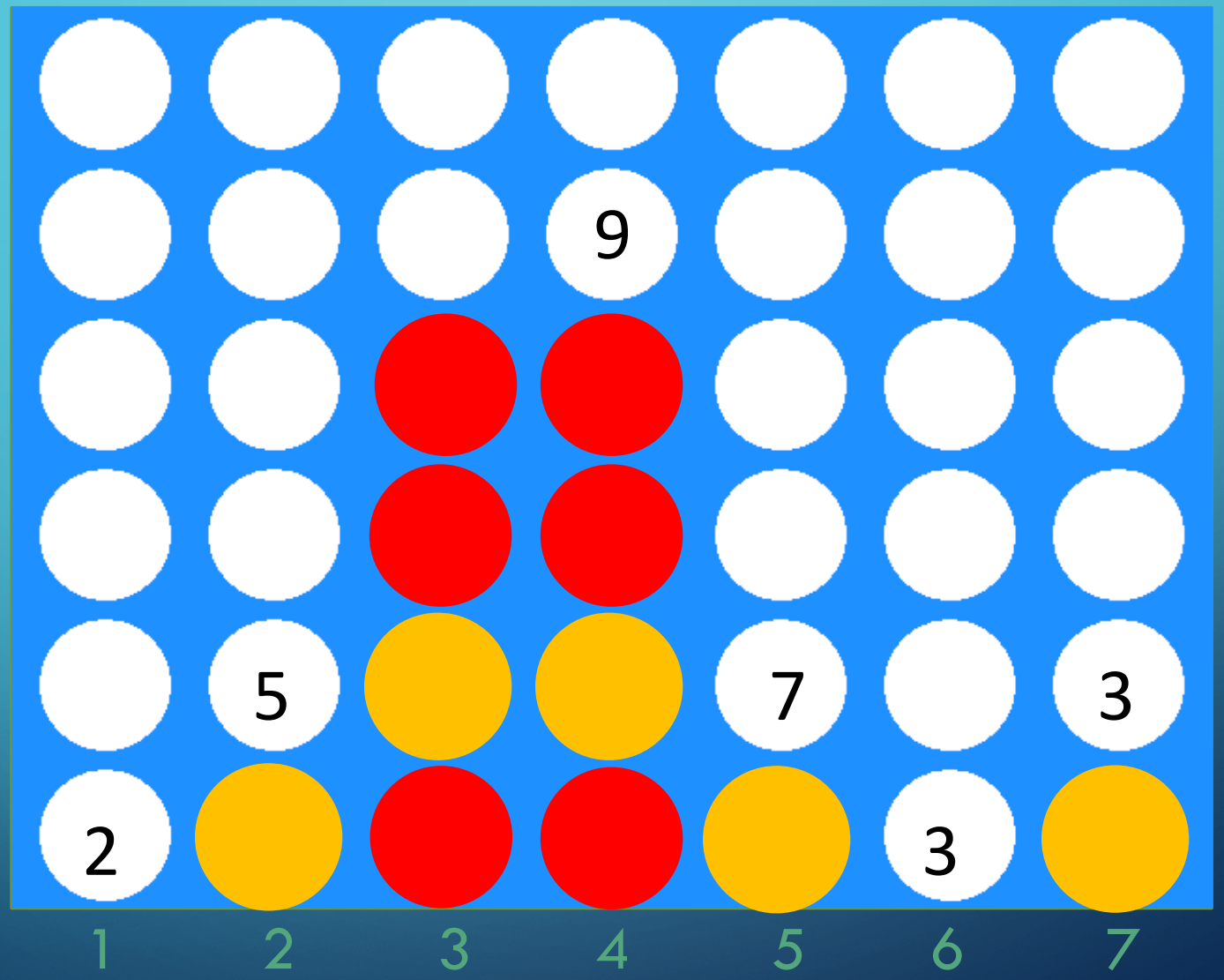
If row #>3 Then
row #=7-row #

Rank of column=
1+(column #)*(row #)

Example

Computer

Player



PRODUCTION I: BILL OF MATERIALS

Prototype Cost Analysis		
A. Mechanical Components	Description	Cost
Bamboo Skewers	1 Pack 6in (set of 100)	4.00
Hard insulation foam	1 2in x 2ft x 8ft board	19.65
Lego Set	1 Basic Bricks deluxe kit	40.00
Balsa Wood Sheet	1 4in x 36in x 1/8in sheet	10.00
Connect Four Game	Game with pieces included	12.00
Vinyl Tubing	1 length 1/2in x 4 ft	4.00
Hot Glue	-	6.00
	Subtotal	$95.65
B. Electronics	Description	Cost
Microcontroller	Basic Stamp w/ board of education	99.00
Ping Sensor	Parallax Brand	22.49
Continuous Servo	Parallax Brand	13.99
Standard Servo	Parallax Brand	12.99
Accelerometer	Memsic 2125 Dual Axis	22.49
Serial LCD	Parallax 2in x 16 in	29.99
Pushbutton Switch	Digikey	1.00
Misc	Wires, resistors, ect.	5.00
	Subtotal	$206.95
	Total	$302.60

PRODUCTION: COST ANALYSIS

Mass Production Cost Analysis		
A. Mechanical Components	Description	Cost
Bamboo Skewers	1 Pack 6in (set of 100)	4.00
Hard insulation foam	1 2in x 2ft x 8ft board	19.65
3d printed components	-	10.00
Balsa Wood Sheet	1 4in x 36in x 1/8in sheet	10.00
Connect Four Game	Game with pieces included	12.00
Vinyl Tubing	1 length 1/2in x 4 ft	4.00
Hot Glue	-	6.00
	Subtotal	$65.65
B. Electronics	Description	Cost
Basic stamp 2	-	17.00
Ping Sensor	Parallax Brand	15.00
Continuous Servo	Parallax Brand	10
Standard Servo	Parallax Brand	10.00
Accelerometer	Memsic 2125 Dual Axis	18.00
Serial LCD	Parallax 2in x 16 in	25.00
Pushbutton Switch	Digikey	1.00
Misc	Wires, resistors, ect.	2.00
	Subtotal	$98.00
	Total	$163.65

DEMONSTRATION

QUESTIONS?