Liar's dice is a game in which multiple players each have a number of dice and make claims regarding the total number of dice showing a specific numerical value. After a bid is made, the players can raise the bid, challenge the existing bid. Players raise by claiming a higher number of dice or the number on the dice than before. Note that if the player increases the number on the dice, then they can claim any new number of dice.(You can raise 3 twos to 2 fours) When a challenge is made, the round is over and the dice are inspected. If the bid that was challenged was accurate, the challenger loses a die but if not, the last bidder loses a die. This repeats until there is only 1 person left with a die who is the winner.

Our game will be using 4 sided dice instead of the traditional 6 sided dice. It will allow the players to collude with one another to influence other player's dice based on their dice value. Basically, a player can choose such that if they have some specific value on their dice, it will guarantee the other player to have a specific value while keeping his dice values random. This can be used to strategically bid certain amounts. The rest of the game rules are the same as the classical version.

The game will use 2 qubits for each player's dice so a game with 4 players and 3 dice per player would have 24 total qubits. The 2 qubits that represent each 4 sided die will be such that 00 on the qubits means 1 on the "die", 01 means 2 on the "die", 10 means 3 on the "die" and 11 means 4. Initially, all qubits will have a Hadamard gate applied so that there is an equal chance of every possible dice combination. Once a pair of players decide to collude with one player acting on the other player's dice, he can choose a control value and a target value. This will mean that if a randomly selected die from the colluding player has the control value, it will guarantee that the player he chooses to collude with will have the target value on a randomly chosen die. Note that while the players know their dice values, they will not know which die has been randomly selected for the control value(the probability of them getting it right increases as the number of dice decreases making the game more interesting as it progresses)

This collusion will be achieved by using entanglement by applying controlled Hadamard gates in combination with not gates. A controlled Hadamard from one qubit to another will guarantee that if the control qubit is 1, the target qubit is 0. Not gates can be applied to the control qubit before the controlled Hadamard and after the controlled Hadamard so as to guarantee the target qubit being 0 when the control qubit is 0. Not gates are also applied to the target qubit after the controlled Hadamard if we would like the target bit to be 1 based upon the control. Thus we can have it so that if 2 qubits(representing a specific die) have some value, some other die is guaranteed to have a specific value while keeping die outcomes random for the initial die. Note that this entanglement causes interference which greatly increases the probability of measuring specific values for certain qubits(the ones that we have entangled so that they have specific values when others have specific values) and makes 0 the probability of some values for

those qubits. Finally the bits in superposition representing the dice are measured to find out what the dice values are and these are outputted to the player.

The game can be played using input from the player(s). The players will be asked various questions ranging from the number of players to the number of dice per player. The game will ask them how they would like to collude and they can respond with the control value and the target value. After all of this, the players run the program to play the game which will output their dice values and the players bid off screen and input the loser who will lose a die. The program will keep running until only one player has dice and will output that player as the winner. The game is best played with a neutral third party that will deliver each player's dice rolls to each player secretly so as to not make public each player's rolls during bidding.