“Tic –Tac – D’Oh!”

by

TIC TAC TECHNOLOGIES

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Preliminary Project Proposal
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Overview

The basic premise of the project we are proposing is a Tic-Tac-Toe game that a user can play against the computer. It will consist of a vertical play area that will have 9 slots in a 3 x 3 array. The user will manually place a puck in one of the slots on his turn, and the computer will counter by figuring out the best next move and mechanically placing a puck in the appropriate slot. The inputs available to the users will be two buttons: Reset and Submit. The "Reset" button will restart the game and the "Submit" button will notify the computer that the user has made a move. The pucks will be placed into the slots by the computer in three basic steps. Each puck will be popped out of its holding bin by a solenoid. The puck will then fall into the corresponding column by a guide that is rotated by a motor. The puck will then bounce into the correct slot by solenoids that will either allow or prevent the puck to fall through to the next slot. The Handy board will read the inputs of the slots and run a tic-tac-toe program that we will either write ourselves or acquire via the internet.

Mechanical Design and Actuators

Perhaps the most ambitious part of our proposed project is the mechanical design. This element of the Tic-Tac-D'oh! device will deliver "pucks" from a storage area into one of nine slots on the game board. The pucks are driven entirely by gravity, but actuators control the path of the puck so that it falls into the correct slot. A schematic of this device is given in Figure #1.

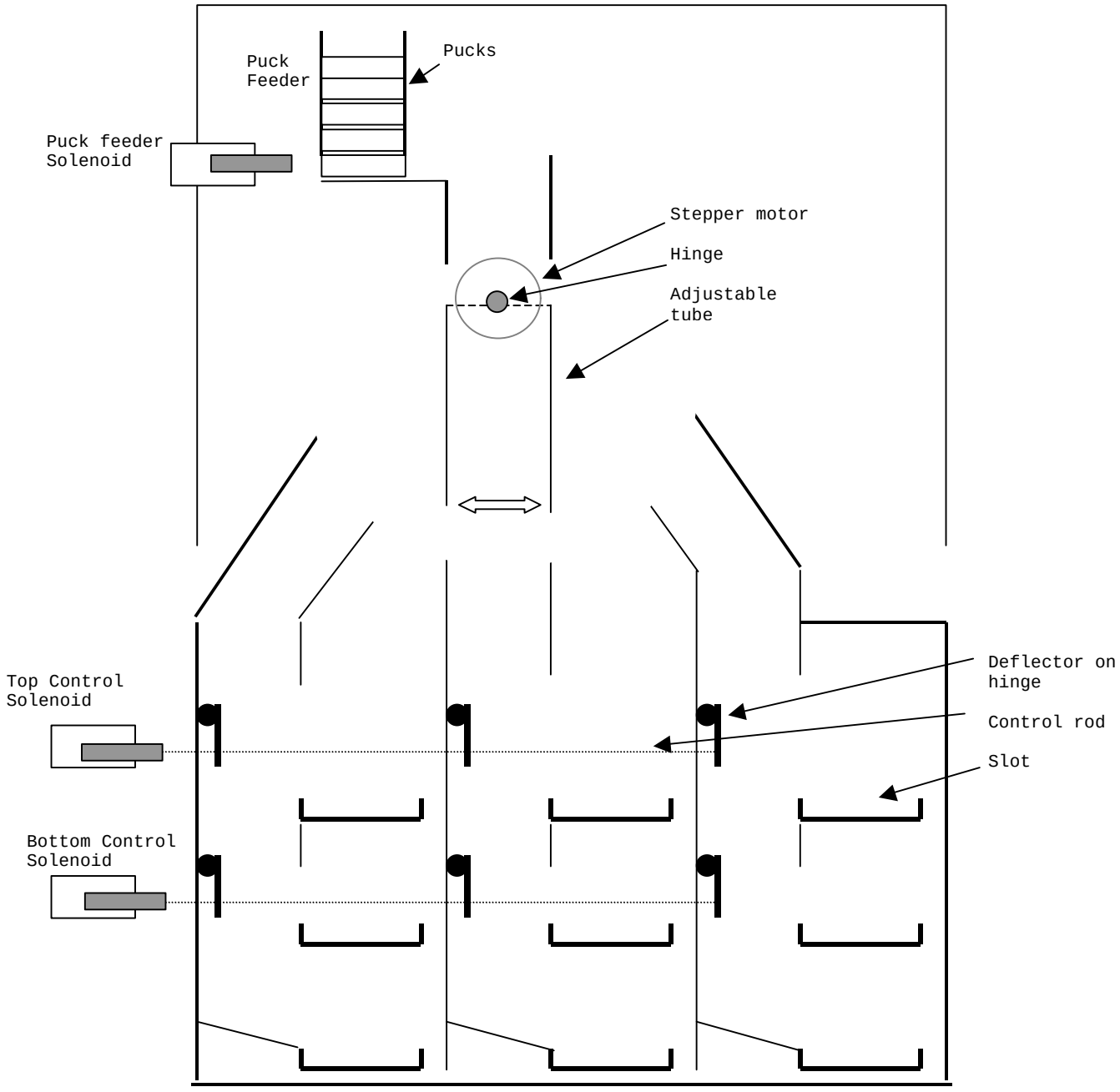
At the top of the device is the puck feeder, when given a signal from the microcontroller, a solenoid pushes a puck off the bottom of a stack and sets it into motion. At the beginning of each game, the player must place all of the machine's pucks in the puck feeder.

There are three actuators that control the path of the puck. First a stepper motor directs the puck into the correct column. This motor is connected to a section of tube that pivots at the top. The tube has three positions – left, straight, or right. If the tube is at the left position, the puck drops into the first column, and so on.

Once the puck is in the correct column, there are two solenoids that divert it into the appropriate row. Each solenoid is coupled to a control rod. The control rods are attached to three deflectors, one in each column. The deflectors are small flaps of metal that are hinged on one side, and the control rod is mounted so that it does not block the path of the puck. When the top solenoid is activated, the deflector directs the puck into the first row, or if the bottom solenoid is activated, the puck is deflected into the second row. If neither is activated, the puck falls into the third row.

The device will be fabricated primarily out of plexiglass and wood. Clear plexiglass will allow the user to watch the puck move inside the machine, and wood sections will hide the wires and actuators.

Schematic of Proposed Project
Figure #1



Sensors

Each slot on the 2-d array contains a reed-switch, and each puck has a small magnet embedded in the center of it, such that the presence of the puck (or lack thereof) can be made known to the processor.

Computation

User Move

Upon placing a puck into the desired slot and pressing the "Submit Move" button, the digital input from this button to the Handy board goes high. A Schmitt trigger may be needed so that the processor does not see multiple "submit move" inputs before it can move, due to noise and/or bouncing of the push button. The processor then checks the remaining free slots of the board to determine where the user placed the puck. Each slot has a magnetic reed-switch associated with it. Upon reading from each remaining sensor, the system representation of the 2d board is updated to reflect changes. The priorities of the slots of the board are then recalculated to reflect the user move.

Priority Update

Upon the beginning of game (ie when the "New Game" button is pressed), the priority of each slot is set to its default. The middle slot has an initial priority of 3 with the corner slots having a priority level of 2, and the middle side and top and bottom slots having a priority of 1. The processor traverses through a few basic rules. When a move is made to a slot, its priority is immediately set to 0 (because no allowable move can be made there). If an immediate move to a slot by any player can cause the game to end, that slot is given a priority of 4 (this priority of 4 is so that it will have a higher priority

than the middle slot in the scenario where the game could end without the center slot being played). The priorities of the other slots are determined by how many possibly winning lines can be drawn through it.

Computer Move

The processor selects the slot with the current highest priority. In the event that more than one slot possesses the highest priority, the slot selected is determined by the processor playing out the two scenarios and calculating if a) a win occurs or b) if selecting the slot gives an immediate priority of 4 to any remaining slot. If a) happens, then that slot is selected. If b) happens, then the other slot is selected. If neither occurs, then the processor randomly selects between the two or more slots in question

To actually move the puck, the processor converts the 1-D representation of the slot to a row and column combination. The processor sends a signal to the puck dispenser and a delayed signal to a stepper motor, orienting it towards the column desired. In addition, a signal is sent activating the solenoid of the desired row.

After Move

After each move, the processor checks to see if a player has won by examining all the different possibilities of winning. In case of a win, the processor displays “You won” or “You lost”, depending on the outcome.