DUEN

DUEN Tabling Machine (DTM)

Fall 2025 Cohort

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Overview

Tabling events often suffer from a lack of student engagement, as many want to avoid awkward interactions and long boring conversations about clubs that they won't find an interest in. Our project was created to circumvent this issue and engage students with the club through a fun and interactive experience. Additionally, the DTM allows onlookers to understand the skills DUEN helps cultivate and the experience they could gain if they were to join. The compact and lightweight design alongside the handles make for easy transportation to and from events and the removable plexiglass backplate enables officers to access the internals of the machine for cleaning and maintenance.

Functionality

The DTM has a screen where people can start a game of Flappy Bird by lifting their arms up. Players can then move their arms up and down to control the movements of the bird, which is achieved through tracking technology. Players must move through 5 pipes in order to win. We used a Raspberry Pi 5 AI Camera alongside Google's MediaPipe Pose AI to focus on points– specifically the wrists, the shoulders, and the elbows to detect a flapping motion. There are two states: true (flap) and false (reset). The game will start in false. Using pose estimation, the camera detects the user's wrists when they pass the shoulder and through that, a signal is sent back to the Raspberry Pi 5 microprocessor which detects a flap, changing the state to true. The player would flap their arms back down and when their wrists fall below their elbows, the flap signal resets (changing the state back to false). To keep flapping, the player will repeat the arm

movements. The game will run at 30 frames per second and a signal detection will occur every 5 frames, thus the camera will detect a change every 0.167 seconds.

To activate the virtual environment that contains all the libraries and dependencies in the terminal we have our command [source .venv/bin/activate]. In order to start the game, we use the command [make run] which starts python main.py. These commands are the basis of our game.

To define an event in the game, there are two states: flap_up and flap_down. flap_up is defined as raising the wrists above the shoulders, while flap_down is defined as the wrists falling below the elbows. Once they make it through five pipes, they will win, and a physical wheel will spin. The wheel is set on a rigged mode.

On the rigged mode, the wheel will be programmed to land on 4 of the 8 possible outcomes that the wheel holds. The options are a sticker, candy, or a flyer. The multiple options gives guests the illusion that there is a possibility of landing on one of the other options that is not a flyer. Due to a multiple component dispensing system being impractical and not fitting into our design, we opted for the flyers to be given through the dispensing system (which will be talked more about later) while other prizes will be on the side to be handed out manually.

Ideally, the table should be placed approximately 36-40 inches off the ground. This number is flexible within the range of ±3 inches, but we found that the most ideal heights were in the ranges between 36 and 40 inches.

User Guide

How To Play:

1. Turn on the machine and connect to the wifi.
2. Position yourself in front of the camera and step back about 5 steps. (Make sure you are the person closest to the camera as the camera focuses on the person closest.)
3. Raise both arms above your head to start the game. The game will start in 3 seconds.
4. Bring your arms out to the side and move your arms up and down to navigate between all the pipes.
5. Pass through 3 pipes to win the game.

Emergency Shutoff Information:

1. Locate Emergency Shutoff button (red button)
2. Press Emergency Shutoff button
3. Motors will stop spinning and will terminate IMMEDIATELY
4. Manually move back the tray, door, and wheel to its original position

For Transportation:

1. Keep the machine in an upright position.
2. Carefully pick up the machine with one hand supporting the bottom and another on one of the walls for better grip, or both hands on the bottom with the back of the machine leaning against your chest
3. Avoid touching the screen when moving.

4. When placing the device down, please make sure that the machine sits upright and not sideways. This is to help ensure that all the places will stay in place and will prevent future wear and tear.

DO NOT:

1. Expose the machine to water (water will short circuit the electrical components due to the open design)
2. Touch the circuitry without proper supervision (this is a safety hazard and may cause electrical burns)
3. Have a third party step in front of the camera (as the camera will track the person who steps in front of the camera instead of the desired target)

Design/Manufacturing Procedure

Mechanical/Electrical Components:

The exterior of the DTM holds custom 3D printed plates with the DUEN logo carved out on the sides of the machine. The DTM utilizes a Raspberry Pi 5 as the central processing unit of the entire machine. Composed of PLA for the external and PETG for the parts that take heavier load, the DTM houses multiple sections, including the flyer dispensing mechanism, a small box to house the electronics, and a portion to insert the LCD Screen. The main electronics are as

follows: ribbon cables to connect the AI camera to the Raspberry Pi, a rechargeable 12V lithium battery to power the entire system, an aluminum heatsink for the Raspberry Pi responsible for the cooling of the system, a breadboard to organize all the wires, and an SD card. The flyer dispensing mechanism consists of a sliding tray utilizing a rack and pinion mechanism to push it back and forth. A gear attached to the motor engages with a long bar with teeth (rack) attached to the bottom of the tray. As the gear rotates, the tray extends or retracts depending on the direction of rotation.

Challenges and Resolutions

Camera Placement:

We had challenges with the placement of the camera as different users have different heights. Considering that the camera would be placed at the top of the Tabling Machine, it would be harder for the camera to detect someone relatively shorter. To counteract this, we decided to place the camera horizontally so that it can detect the arms and shoulders of players at a wider range. We also had a program that displayed what the camera saw, so we were able to make adjustments accordingly. Similarly, height is variable. If we encounter someone relatively shorter, we may ask them to stand on something so the camera detects them. Similarly, if the person is relatively taller, we may ask them to sit down instead.

Flyer Dispensing:

We ran into a slight issue with the final design of the mechanism that dispenses the flyer. The original idea involved having the flyers sit in a curved tray connected to a stepper motor via

string. When the door is closed, the string is slack but the tray remains in an upright position due to the door still being in place. When the door is opened, the tray would slide out, displaying the flyers. The motor then winds the string around a spindle to return the tray back to its original position before the door closes. We decided not to proceed with this design as we were concerned about complications with the winding of the string. Instead, we decided on a sliding tray utilizing a rack and pinion mechanism to push the tray in and out of the chassis. A gear attached to the motor engages with a long bar with teeth (rack) attached to the bottom of the tray. As the gear rotates, the tray retracts or extends depending on the direction of rotation. This new system allowed us to extend the tray efficiently and enabled easy access to the flyers.

Wiring Issues:

The battery powering the machine is unreliable and only works in specific positions. Its power supply will also change depending on what it is powering at the moment. So far we will have to be very careful in terms of transportation and try to find a way to stabilize the wires.

Material List and Cost

ITEMS	QUANTITY	COST FOR 1	TOTAL COST
Raspberry Pi 5 (8GB RAM)	1	$87.00	$87.00
Assorted Wires	1	$6.98	$6.98
Ribbon Cables	1	$12.10	$12.10
AI Camera	1	$25.00	$25.00

LCD Screen	1	$38.99	$38.99
Battery	1	$27.89	$27.89
SD Card	1	$12.95	$12.95
Active Cooling Heatsink	1	$9.97	$9.97
BreadBoard	3	$1.99	$5.97
String	1	$4.99	$4.99
Glue	1	$7.99	$7.99
Nuts and Bolts	3	$6	$18.84
Buck Converter	1	$10	$9.99
Stepper Motor	3	$9	$28.35
Stepper Motor Driver	3	$10	$30.57
fuse box	1	$11	$11.43
Buttons	1	$8	$7.99
PLA Filament	2	$16	$31.98
PETG Filament	1	$16	$15.99
Mesh Fabric	1	9.99	$9.99
Tape	1	5.99	$5.99
Nylon String	1	6.99	$6.99
Plexiglass	2	12.49	$24.98
Spray Paint	1	35	35

Final Production Cost: $477.92

Maintenance

1. Check if the wire connections are still intact
2. Check the internal components for shorts, general damage, or heat damage
3. The string that pulls the door may need to be replaced occasionally
4. Re-gluing internal parts if they start lifting
5. Cleaning Exterior and dusting the interior if it starts accumulating dirt

6. Potential cracking in the moving internal parts needing reprinting
7. Ensure that cables are as tight as possible, as they may loosen over time
8. Potential wear on paint exterior can be touched up with more paint