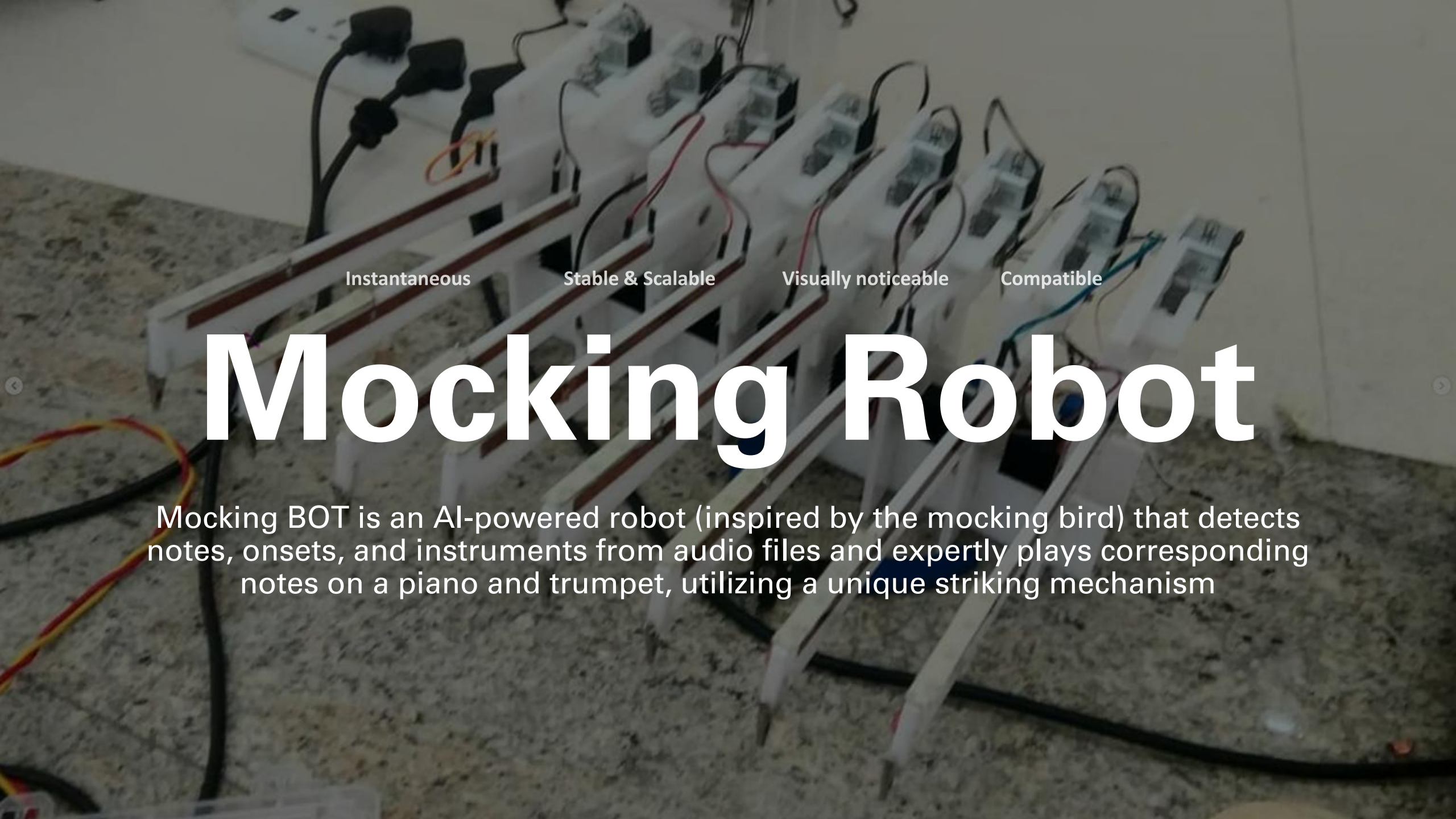
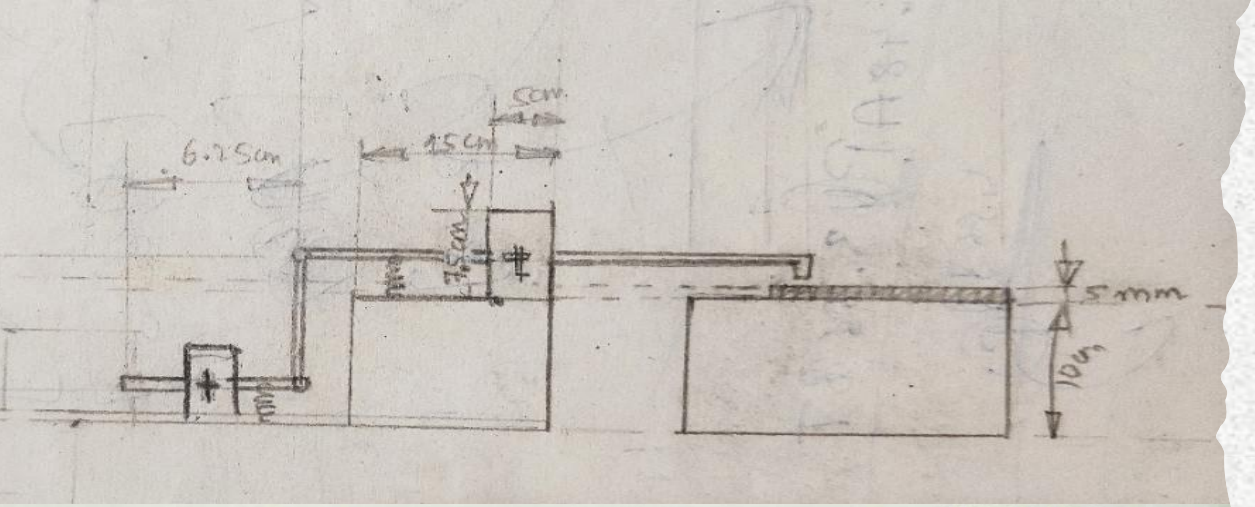
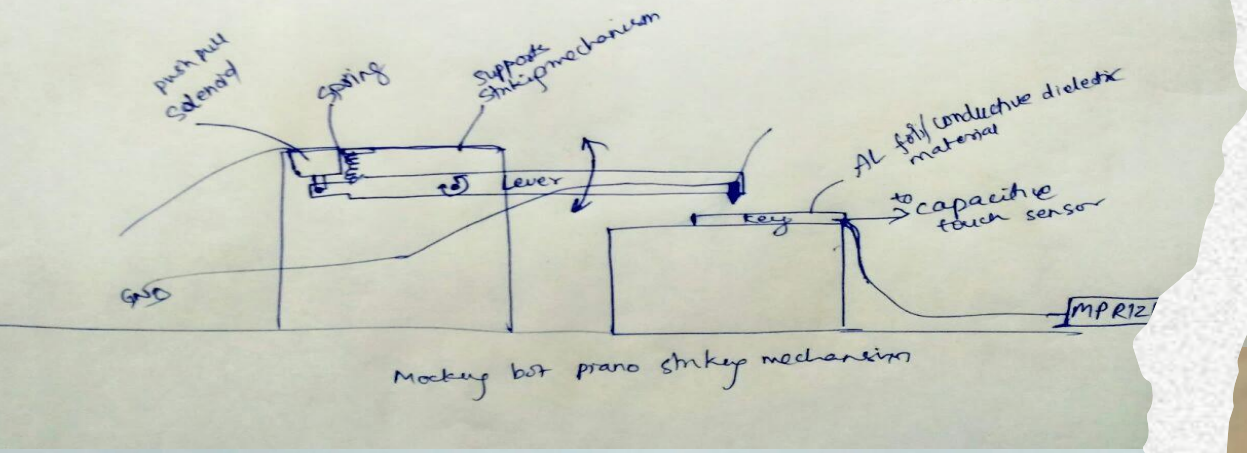
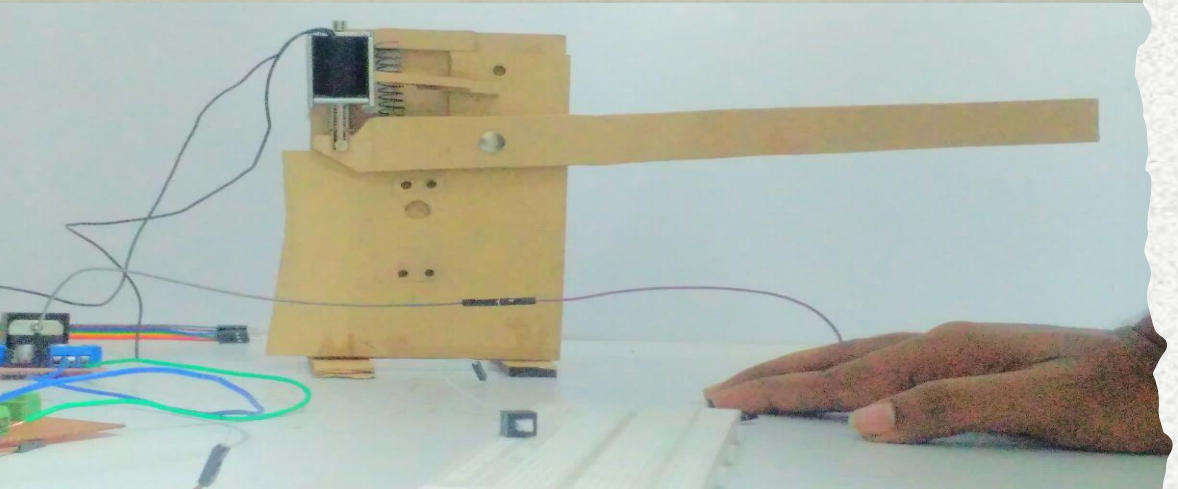

Instantaneous
Stable & Scalable
Visually noticeable
Compatible
Mocking Robot
Mocking BOT is an AI-powered robot (inspired by the mocking bird) that detects notes, onsets, and instruments from audio files and expertly plays corresponding notes on a piano and trumpet, utilizing a unique striking mechanism

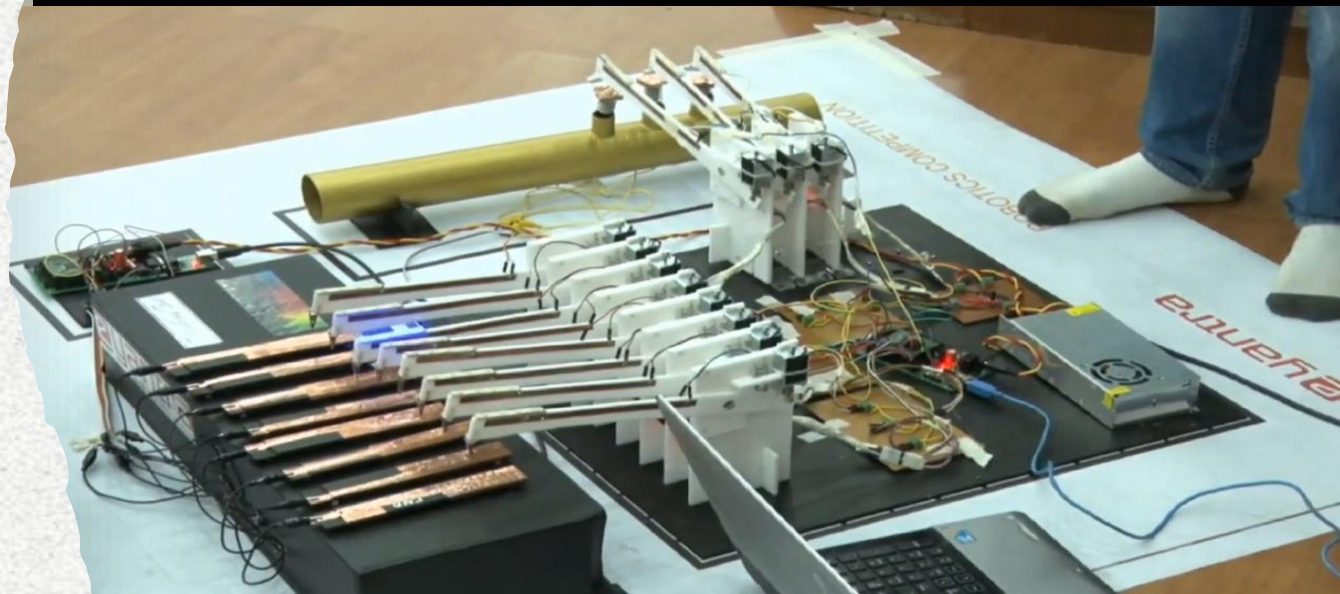






<<The Design

Title:	**Mocking Bot (audio to actuation instrument mimicking robot)**
Project Context:	Developed for the E-Yantra National Robotics Competition (IIT Bombay). The challenge was o translate audio analysis into a visible, physical performance. I wanted to explore how a robot could perform music not just accurately, but intelligibly to a human audience.
Date:	August 2018 - March 2019 EYRC 2018 National Finals
Theme:	Physical interaction, legible feedback, audio ML, mechatronics
Contribution:	1. Designed the solenoid-based striking mechanism, visual feedback system inspired by human fingers, with ~400 ms response time 2. Built and tuned the instrument detection pipeline, reaching 92.6% average accuracy across flute, piano, trumpet, violin

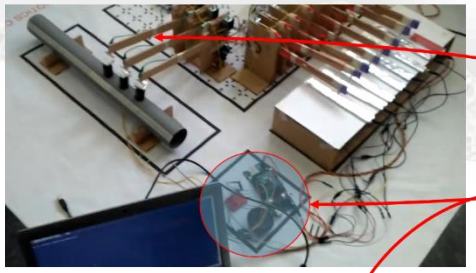


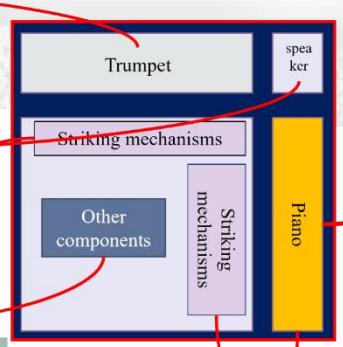
Working Demonstration

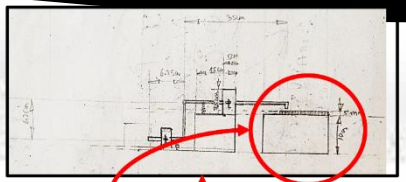
Along with the striking mechanism design, I developed an instrument detection system. I optimized hyperparameters and compared Fourier transforms, accuracy, and entropy of audio files using a novel machine learning approach, thus achieving an average accuracy of 92.6% in detecting an audio file containing four instruments: Flute, Piano, Trumpet, and Violin

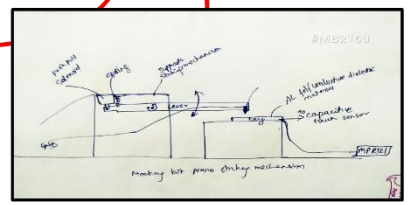
Impact: Ranked 4th nationally among ~7,000 teams

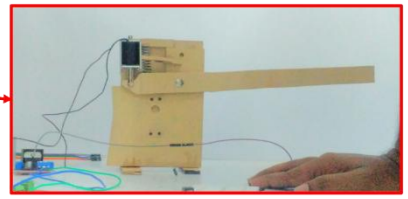
Find Live event demonstration the project on **YouTube** by searching :
“eyrc 18 mocking bot demonstration”
OR “ e-Yantra Robotics Competetion 2018 Day 2/2” at 8:02:10 onwards

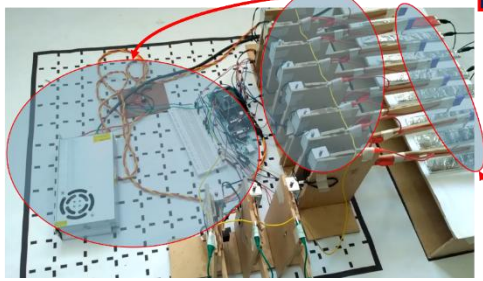


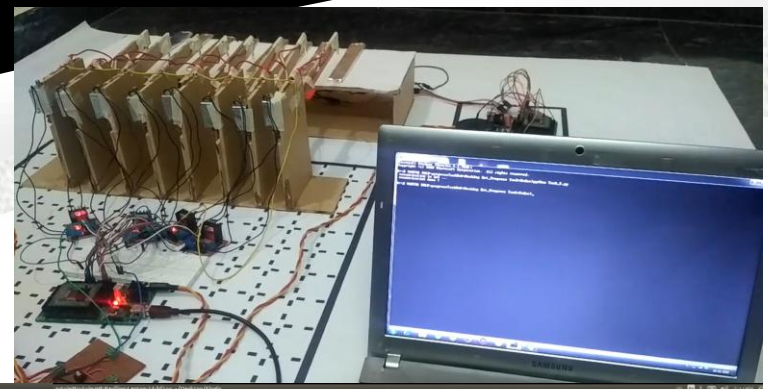












Balance Robot

Title:	Biped Patrol Bot
Date:	Aug 2019 – May 2020
Theme:	Applied physics + control systems + chassis design + sensing
Contribution:	chassis design and mechanical concepting for stability and response.
Impact:	System performance passed tests and advanced to the second stage; trial use exposed a usability failure because the tall design made loading difficult for intended users

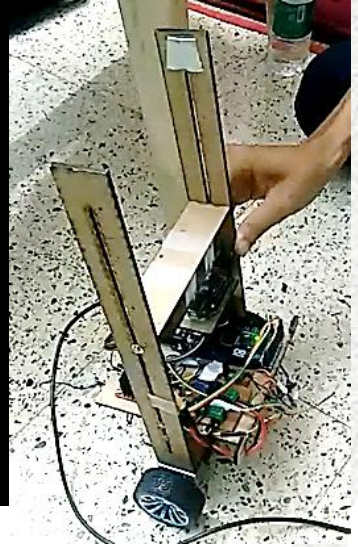
The Balance Bot is a two-wheeled robot capable of maintaining balance without external support. It represents an advancement in solving the classic inverted pendulum problem.

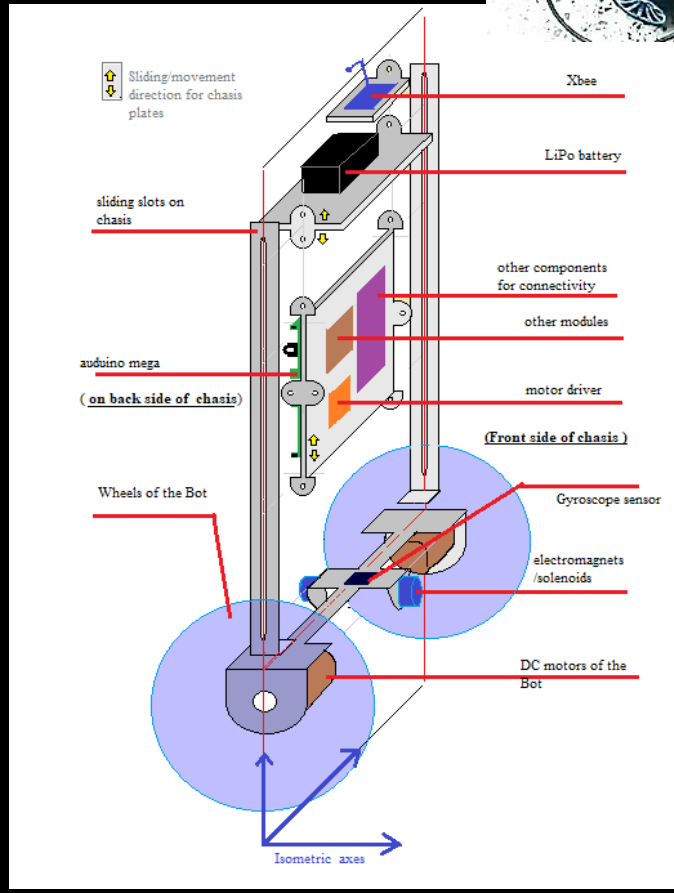
To achieve balance, the robot utilizes an accelerometer and gyroscope to measure the magnitude and direction of its tilt. The signals obtained are then employed to move the wheels in the direction in which the robot is leaning.

Chassis Design>>

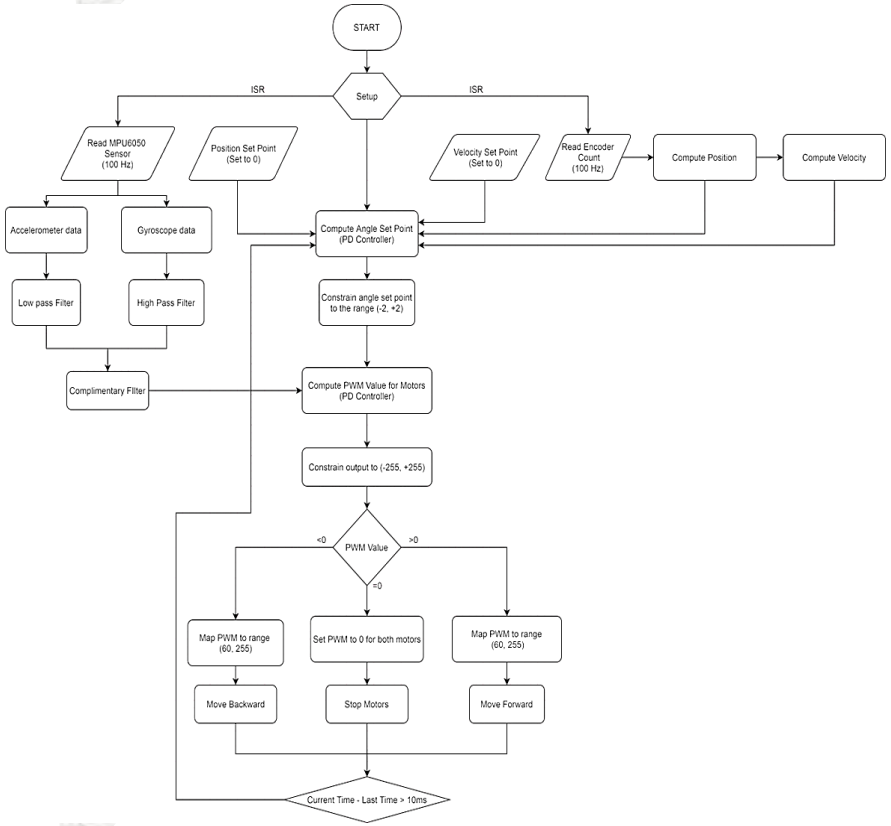
My primary contribution involved formulating and conceptualizing the chassis design for Robot. These are its features:

- Being taller it tilts slowly when external torque is applied. → Stability and Response
- Even Weight Distribution
- Construction features → Modular
- Tiers can be moved up and down to shift the center of gravity as required. → Scalable
- Stackable



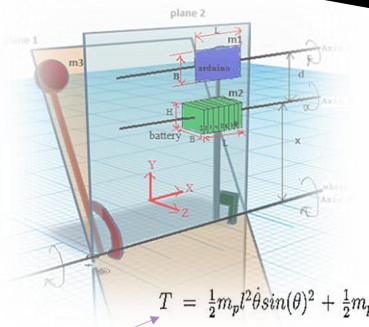


Control Systems Design Flow-Chart



Behind the scenes
(Applied Physics and Control systems)

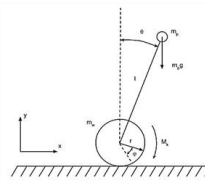
Here is a glimpse into what transpired during the making of this robot..



Mathematical Model

$$T = \frac{1}{2}m_p l^2\dot{\theta}sin(\theta)^2 + \frac{1}{2}m_p r^2\dot{\phi}^2 + \frac{1}{2}m_p l^2\dot{\theta}^2 cos(\theta)^2 + m_w r^2\dot{\phi}^2 + \frac{1}{2}m_p l^2\dot{\theta}^2$$

Kinetic energy & Potential energy equations → $\Pi = m_p glcos(\theta)$



m_p: pendulum mass
m_w: wheel mass
l: pendulum length
r: wheel radius
θ: angle between the pendulum and the vertical line
ϕ: angle of rotation of the wheel relative to its initial position
M_k: motor torque

Euler-lagrangian function → $L = T - \Pi$

$$L = \frac{1}{2}m_p l^2\dot{\theta}sin(\theta)^2 + \frac{1}{2}m_p r^2\dot{\phi}^2 + \frac{1}{2}m_p l^2\dot{\theta}^2 cos(\theta)^2 + m_w r^2\dot{\phi}^2 + \frac{1}{2}m_p l^2\dot{\theta}^2 - m_p glcos(\theta)$$

Apply Euler Lagrange theorem

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}(q,\dot{q})\right) - \frac{\partial L}{\partial q}(q,\dot{q}) = \tau$$

Euler-Lagrange equation

Derive equations of movements →

$$rcos(\theta)lm_p\ddot{\theta} + r^2(m_p + 2m_w)\ddot{\phi} - rsin(\theta)\theta^2 lm_p = M_k$$
$$\ddot{\phi}cos(\theta)lm_p r - m_p glsin(\theta) + 2m_p l^2\ddot{\theta} = 0$$

Obtained system of equations(mathematical model) in matrix form

we linearize the obtained equations of motion in neighborhood of the zero position of the pendulum using Jacobians:

$$\frac{d}{dt}\begin{bmatrix}\phi\\ \dot{\phi}\\ \theta\\ \dot{\theta}\end{bmatrix} = AX+BM_k = \begin{bmatrix}0 & 1 & 0 & 0\\ 0 & 0 & \frac{-m_p g}{r(m_p+4m_w)} & 0\\ 0 & 0 & 0 & 1\\ 0 & 0 & \frac{g(m_p+2m_w)}{l(m_p+4m_w)} & 0\end{bmatrix}\begin{bmatrix}\phi\\ \dot{\phi}\\ \theta\\ \dot{\theta}\end{bmatrix} + \begin{bmatrix}0\\ \frac{2}{r(m_p+4m_w)}\\ 0\\ \frac{1}{lr(m_p+4m_w)}\end{bmatrix} M_k$$

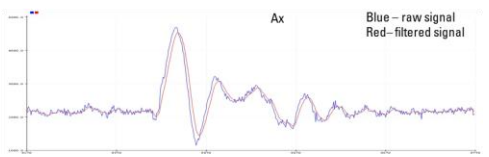
A – state matrix
X – state vector
B – input matrix
Mk – input vector

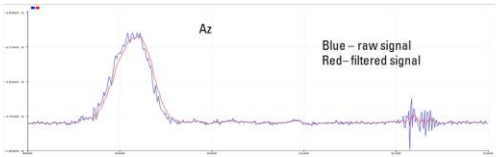
Cart Pendulum Model Simulation

The Goal of the Cart Pendulum model is to keep Upright by moving the cart in the direction of the falling mass

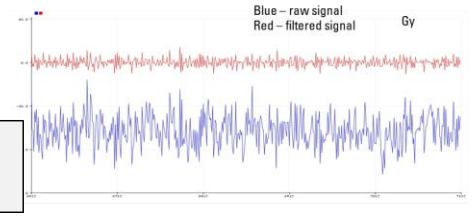
Sensor Fusion Results

Low Pass Filter (Used to filter Accelerometer data) allows lower bandwidth to pass
Calculation of the Pitch angle using Accelerometer is done using the formula
acc = arcTan(Ax / Az)
First we pass the signals Ax and Az through Low pass filters, then we find the angle acc
f_cut= 5, dt = 0.01, alpha = 0.76

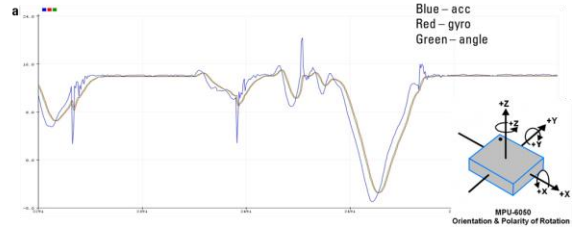




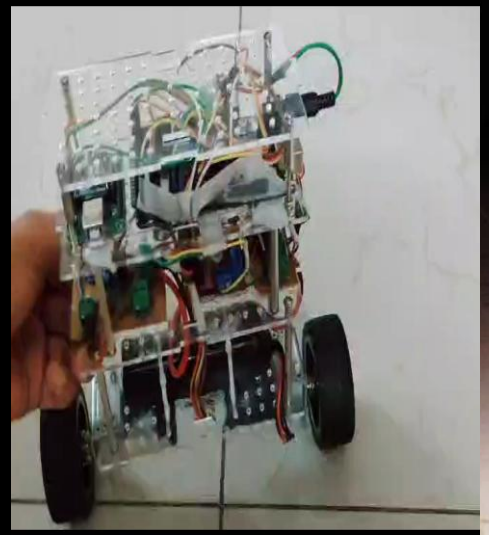
High Pass Filter (Used to filter Gyroscope data) allows Higher bandwidth to pass) The gyroscope data **Gy** is taken **f_cut= 5, dt = 0.01, alpha = 0.76**

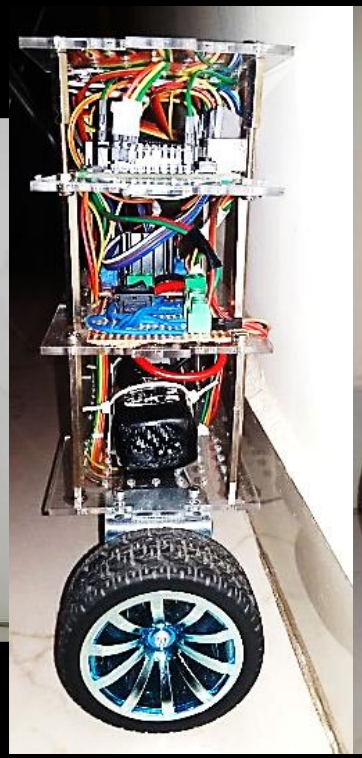


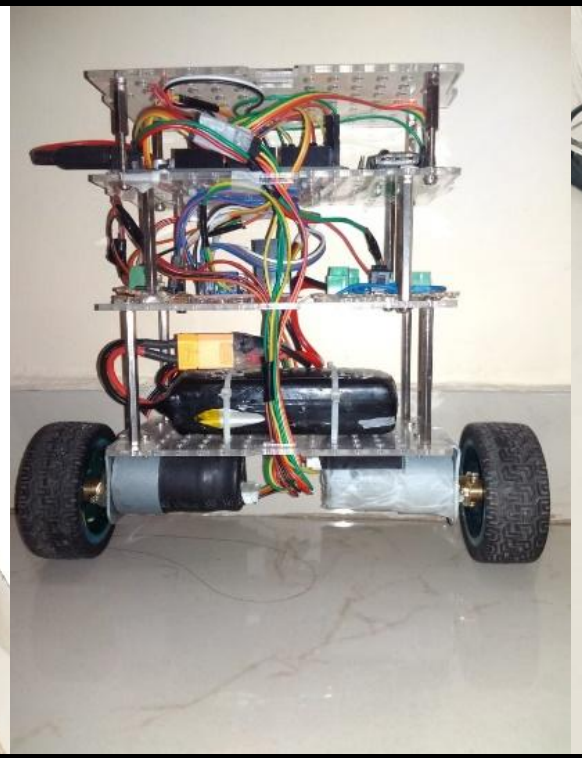
Complimentary Filter(Used to combine Accelerometer and Gyroscope data)
angle = (1- alpha)(angle + gyro * dt) + (alpha)(acc) The first reading is the angle as obtained from gyroscope integration. The second reading is the one from the accelerometer

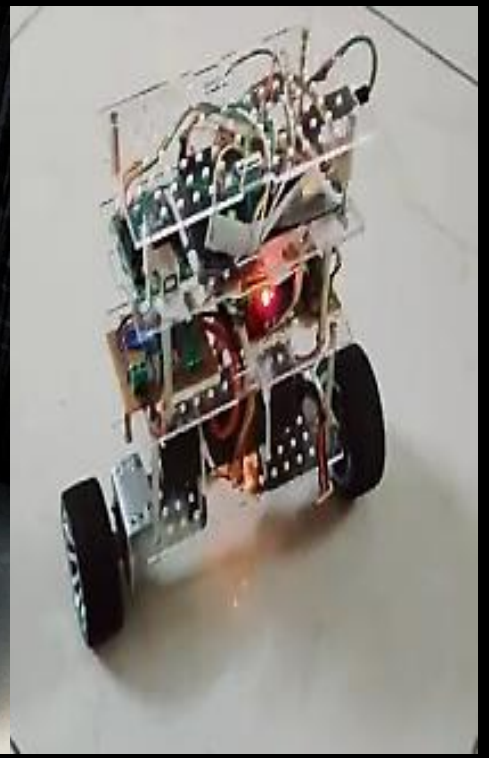


Pictures of Final robot at different angles









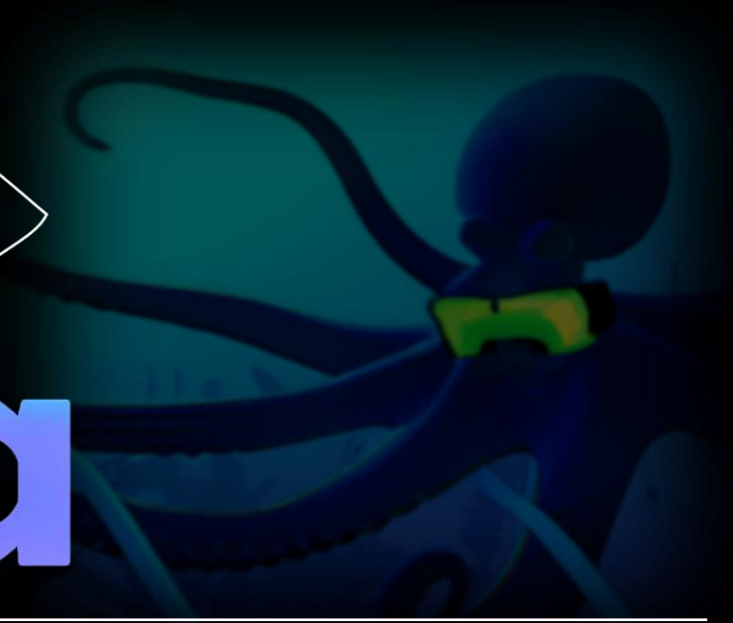
AMNE

derived from the Greek word ‘amnesia’, referring to the loss of memory or the inability to recall

SEA

represents an expansive body of water, often associated with vastness, depth, and mystery

amnesea



Title:	Amnesea + Game titles
Project Context:	Built a studio to own the full loop: concept → prototype → playtests → pitch → partnerships.
Date:	December 2023 – present
Theme:	Entrepreneurship + interactive media + UXR decisions
Contribution:	• Lead creative direction, systems design, and prototype development. Run operations: budgeting, funding, legal coordination, event planning, platform partnerships. Translate playtest observations into scope decisions and production plans (Xbox Game Camp apprenticeship). • As the co-founder and CEO, I've had the incredible opportunity to exhibit interactive prototypes at IGDC(2024,2024) conference, gathering qualitative user feedback to refine narrative pacing and game loops. The response from attendees, Venture Capital Investors, and publishers has been overwhelmingly positive, which has been incredibly rewarding. IGDC holds a significant place as Asia’s Biggest Game Developer Conference, making our reception even more exciting. • Bootstrapped an indie game studio, secured publishing partnerships with Microsoft Xbox and Sony PlayStation
Impact / outcome:	• Selected for Microsoft Xbox Game Camp Asia (top 16 Asian studios; top 4 India) an intensive accelerator • We have partnered with the Microsoft Xbox team and PlayStation to publish our games on the Xbox Store and Steam. • Our game "TimeBound: History's Legacy" was honored as a Top 10 Finalist in the BYOG Game Jam 2023 • Titles reaching 5,000+ players across multiple events. • We also won about 2,380 USD in AvalancheXNeuranode Jam and Whalepass Global gamejam

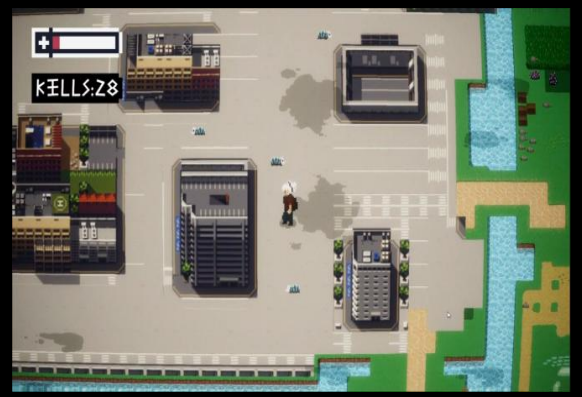
TIMEBOUND

In this unique world, players are not just time travelers but the architects of a new future. Their adventures aren't just about fixing inventions but about rewriting destiny itself, one chapter at a time. An extraordinary mission: restoring the past by fixing inventions and correcting historical anomalies.

This is an ongoing project and currently, we are in talks with a few potential investors including SONY Interactive Entertainment.

A story-based RPG , Top 10 nominations in BYOG game Jam

Gameplay & screenshots

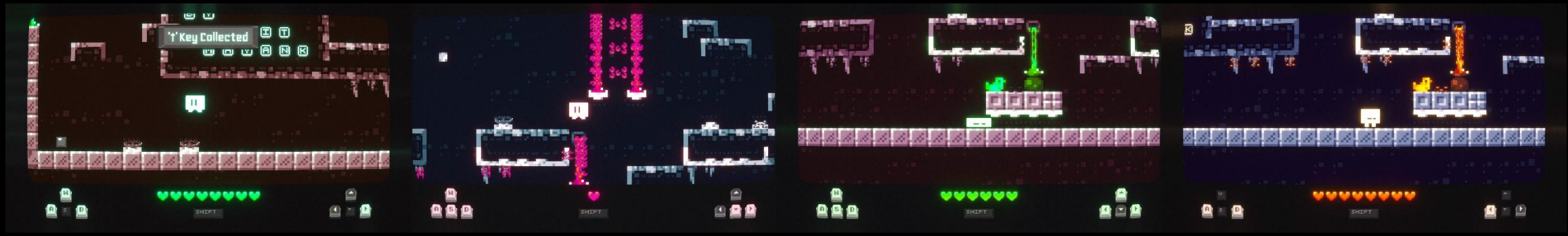


KEY BOUND

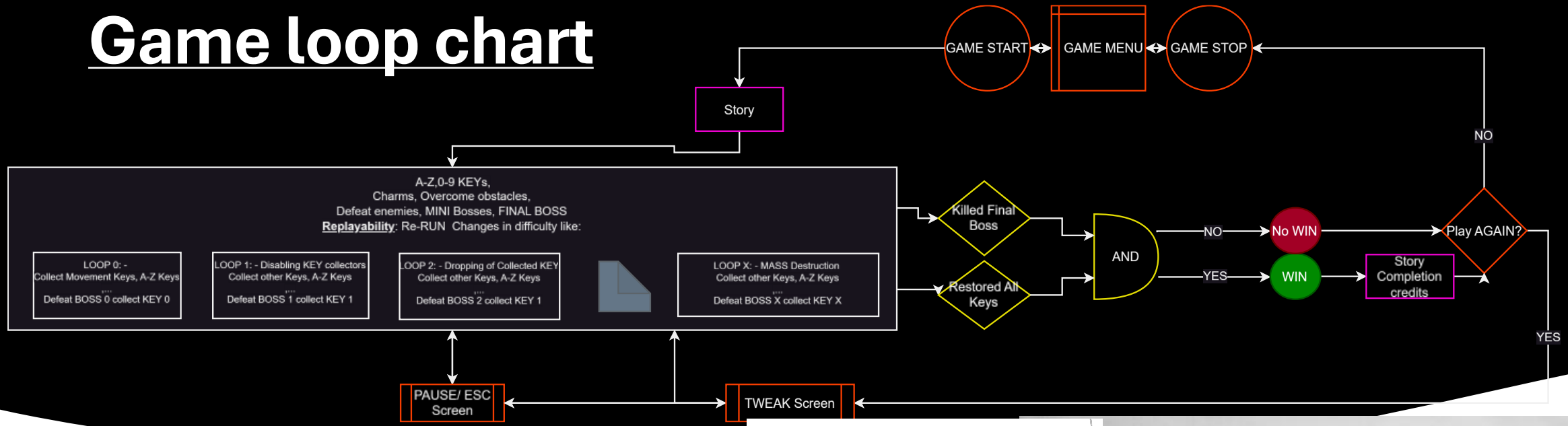
You're a -KEY- inside a -KEYBOARD- which has lost its keys.
Reclaim 'Space' with the 'Limited Keys' that still work to restore your keyboard.

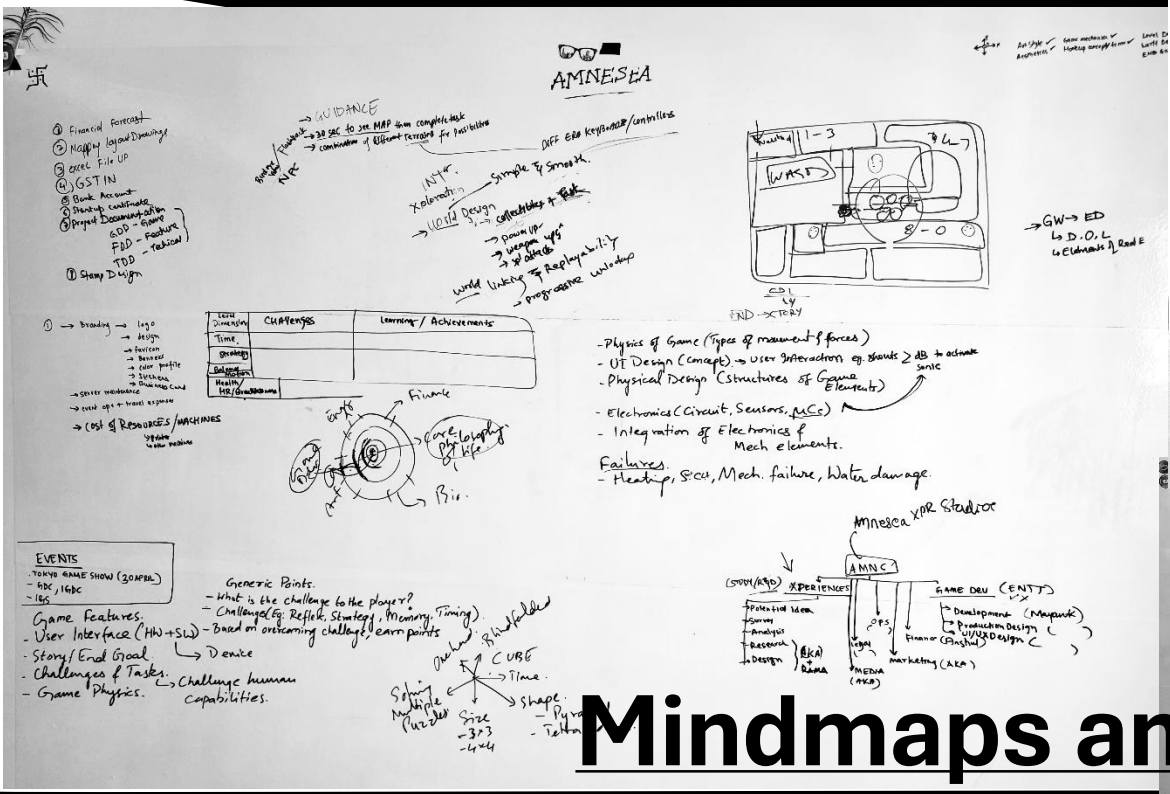
Title:	KeyBound (playable narrative action RPG, RogueVania)
Date:	2024 to present (ongoing)
Project Context:	Built as a real market test where confusion shows up as immediate drop off in play
Theme:	Rule learning through interaction, game design
Contribution:	Oversaw core gameplay mechanics and user experience decisions across the project. Built UXR defining level layout and game economy. Shaped overall aesthetics and produced pitch artifacts.

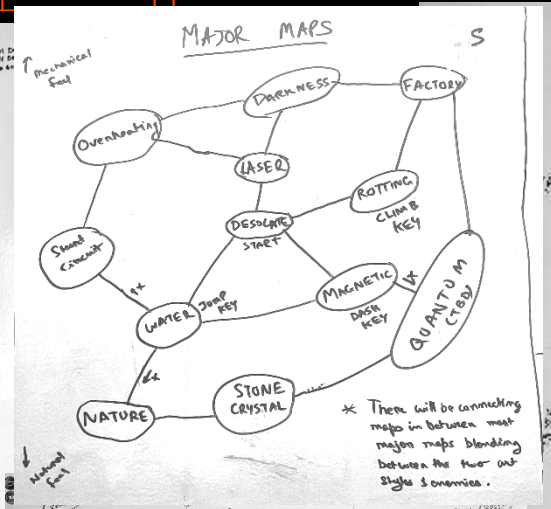
V1 Gameplay & screenshots

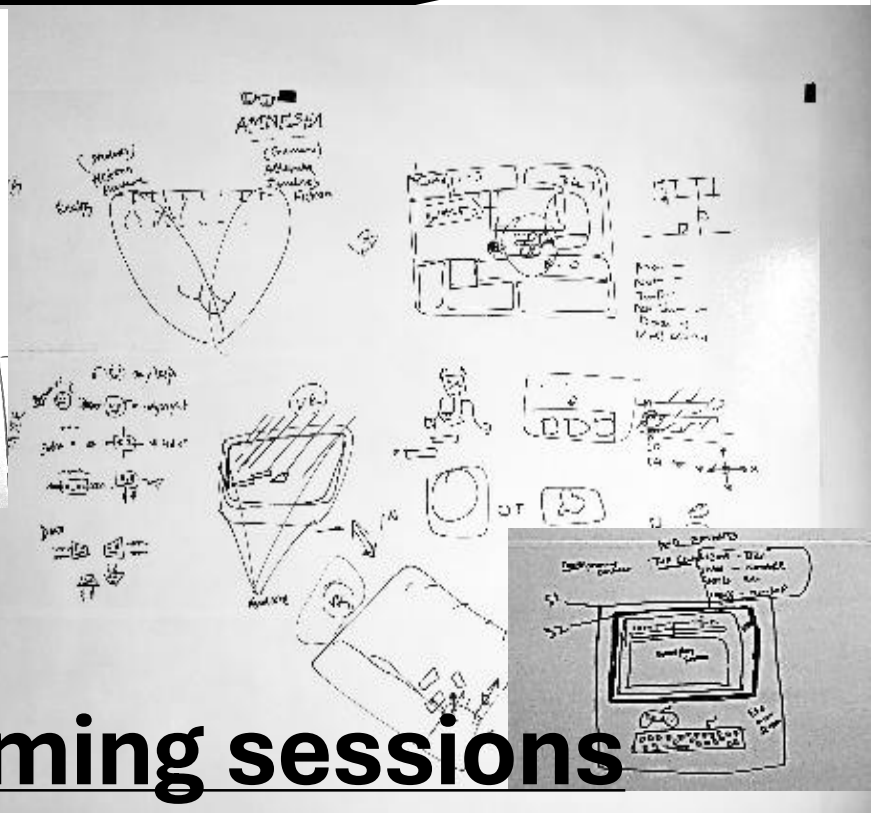


Game loop chart









Mindmaps and brainstorming sessions

V2 Gameplay & screenshots
Art style 2

Media Mentions

"Unique concepts with simplistic gameplay" - First Impressions article on IGN India.

IGN INDIA

"...this art was so cute OML... and I loved the experience of collecting ... I treasure this"

Ludum Dare

Chosen among **Top 4 Indian studios** for Xbox Game Camp Asia *2024*.

XBO GAME STUDIOS GAME CAMP ASIA

"...concept of getting power by getting keys is nice, it could make a great Metroidvania..."

itch.io

Game development in India: Youngsters are taking lead.

Bennett & Coleman
THE TIMES OF INDIA

KEY BOUND

Diabetic Retinopathy detection

Title:	Diabetic Retinopathy screening and grading using deep neural networks
Date:	2020 (publication July 2020; additional publication Oct 2020)
Theme:	Applied ML for health, data quality constraints, translating predictions into clinical meaning
Contribution:	Designed the CNN (Convolutional Neural Network) architecture. Managed dataset preprocessing (clahe, resizing). First Author of the published paper.
Impact:	• Achieved 97.46% Classification Accuracy. • Published in IJETER (Vol 8, No 7). • Design Insight: High accuracy is useless if the system is a "Black Box." This drove my interest in building interfaces that explain why an AI made a diagnosis.

Diabetic Retinopathy is a complication of diabetes characterized by damage to blood vessels in the eye. As of 2020, over 100 million adults worldwide have been diagnosed with this condition. It is classified into four stages based on severity:

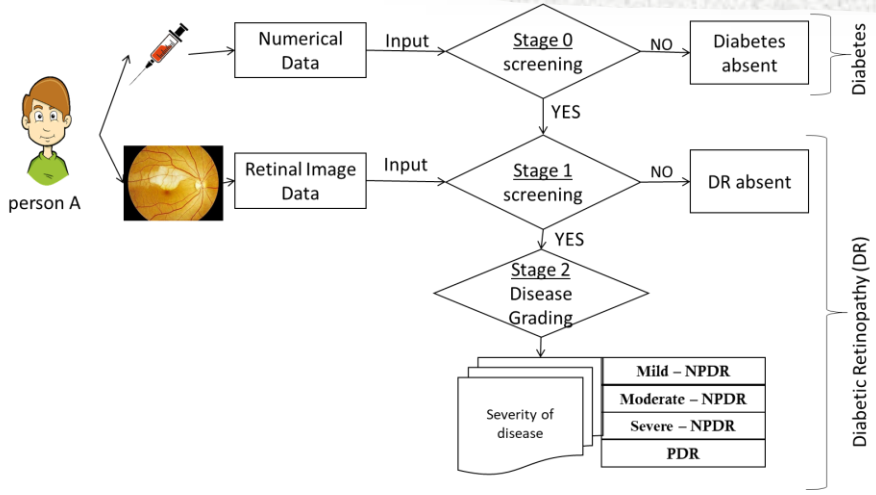
Prediction Methodology

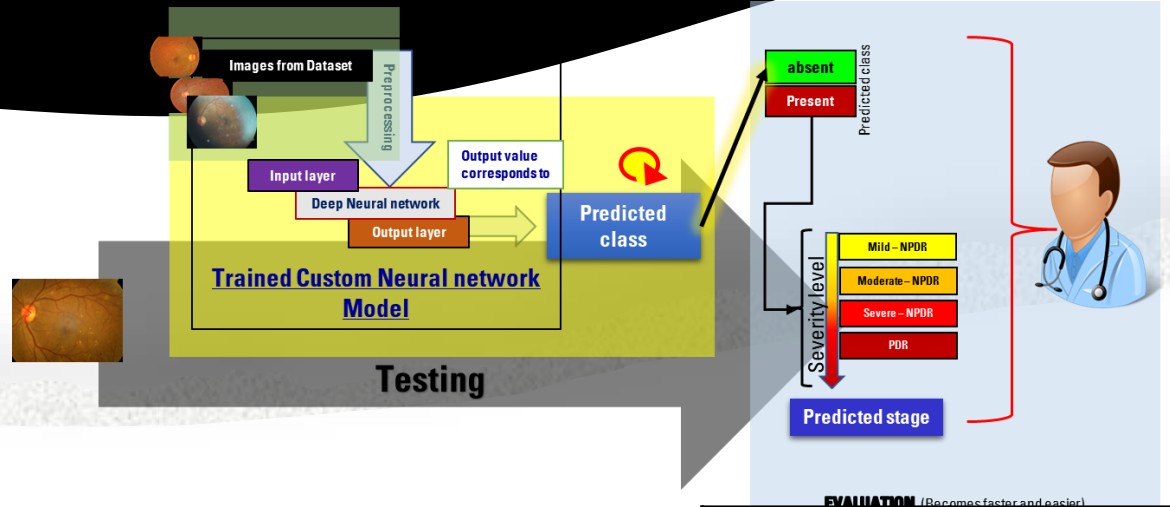
Working Glimpse / Results

I have developed a neural network for Diabetic Retinopathy detection, optimizing hyperparameters and comparing pictorial and numerical data accuracy using a novel machine learning approach. Thus, achieving an average accuracy of 72.6%.

Class label	Disease Severity Level	Findings	Sample Retinal Images
0	Grade – 0: No apparent retinopathy	No visible sign of abnormalities	
1	Grade – 1: Mild – NPDR	Presence of Microaneurysms only	
2	Grade – 2: Moderate – NPDR	More than just microaneurysms but less than severe NPDR	
3	Grade – 3: Severe – NPDR	Any of the following: ▪ > 20 intraretinal hemorrhages ▪ Venous beading ▪ Intraretinal microvascular abnormalities ▪ no signs of PDR	
4	Grade – 4: PDR	Either or both of the following: ▪ Neovascularization ▪ Vitreous/pre-retinal hemorrhage	

Severity level





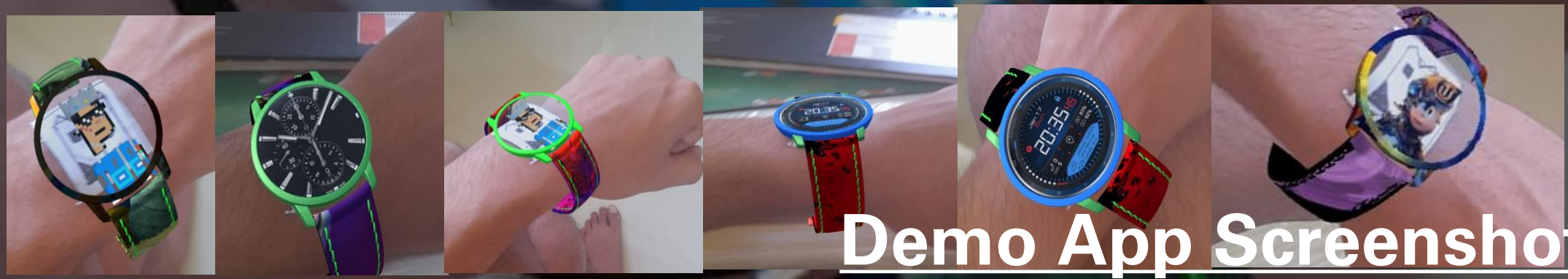
Binary stage 1 using NN of custom architectures		Kernel size	Activation function	Number of epochs	Max Accuracy achieved (%)	Loss achieved
Network architecture used	Changed network version name					
7 CONV layers, 4 dense layers	Version 1	7x7	ReLU	40	91.45	0.0835
23 CONV layers, 2 dense layers,	Version 2	3x3			80.38	0.524
	Version 3	2x2			80.18	0.529

	Class 1 - Predicted	Class 2 - Predicted	Class 3 - Predicted	Class 4 - Predicted
Class 1 - Actual	52	9	14	2
Class 2 - Actual	23	143	10	25
Class 3 - Actual	3	1	28	2
Class 4 - Actual	7	4	7	41

Augmented Reality Watch NFTS

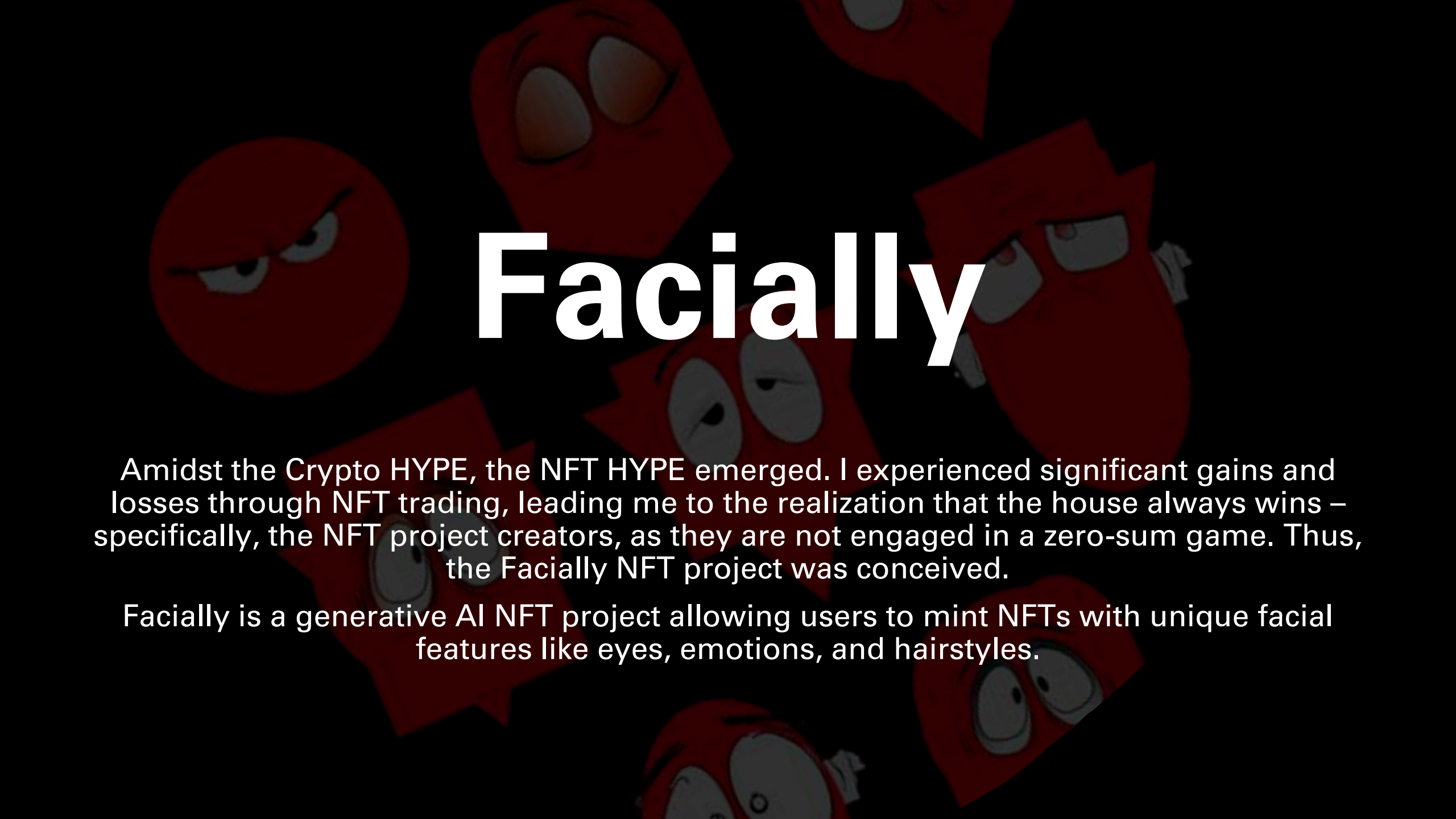
These Fashion NFTs are crafted for Wearable, interactive, and realistic experiences. Below is the PowerPoint presentation that my teammates and I prepared for pitching to AR developers, marketers, artists, and investors.

Title:	AR Watch & Facial Generative Identity
Project Context:	An exploration into Web3 and Augmented Reality. I wanted to investigate how digital identity (generative art) could bridge into physical space through wearable AR.
Date:	2020-2021
Theme:	Emerging Tech, Web3 & Digital Fashion
Contribution:	Programmed the generative art algorithm (Python) to create unique trait combinations. Built the AR visualization prototype (WebAR) to overlay watches on wrists.
Impact:	Successfully launched a generative collection on the blockchain. Design Insight: Technology must solve a user need, not just demonstrate a capability. This failure pushed me toward the more grounded, user-centric work I do now.



Demo App Screenshots

Unfortunately, the project had to be discontinued due to the infeasibility of integrating WEB AR Technology with wrist tech.



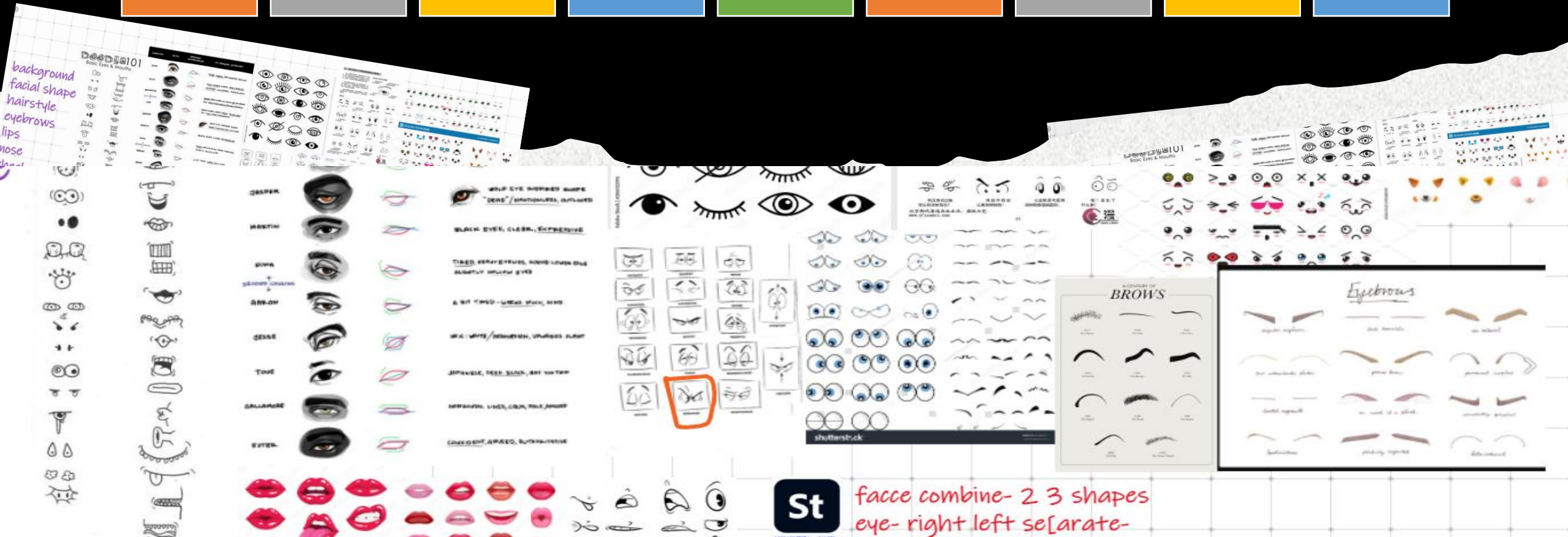
Facially

Amidst the Crypto HYPE, the NFT HYPE emerged. I experienced significant gains and losses through NFT trading, leading me to the realization that the house always wins – specifically, the NFT project creators, as they are not engaged in a zero-sum game. Thus, the Facially NFT project was conceived.

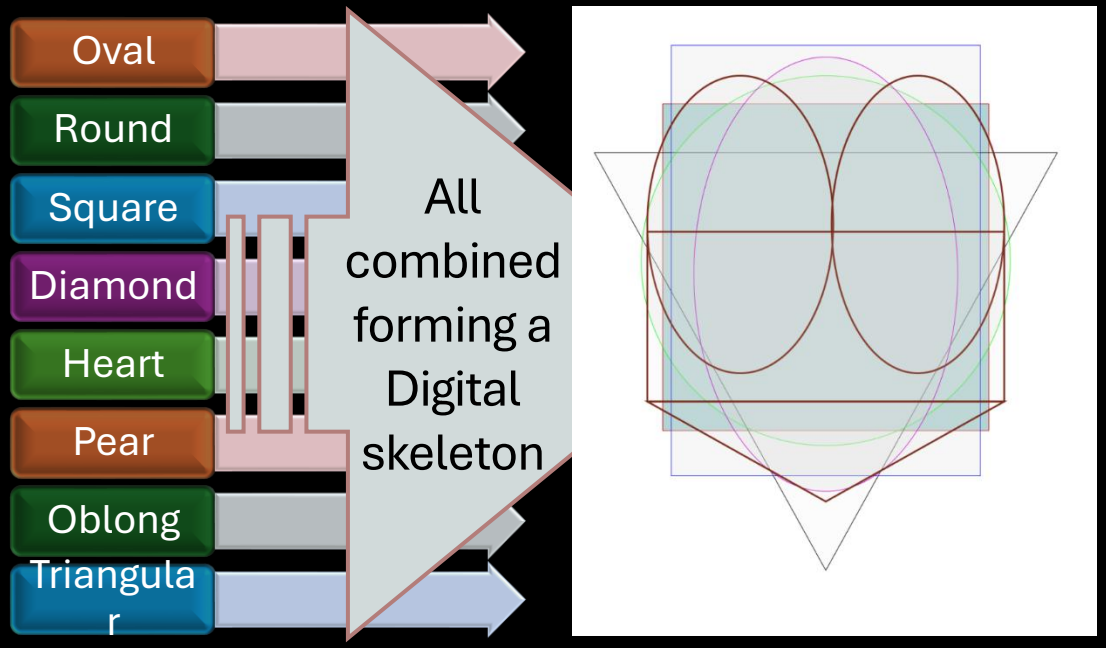
Facially is a generative AI NFT project allowing users to mint NFTs with unique facial features like eyes, emotions, and hairstyles.

Attributes and research

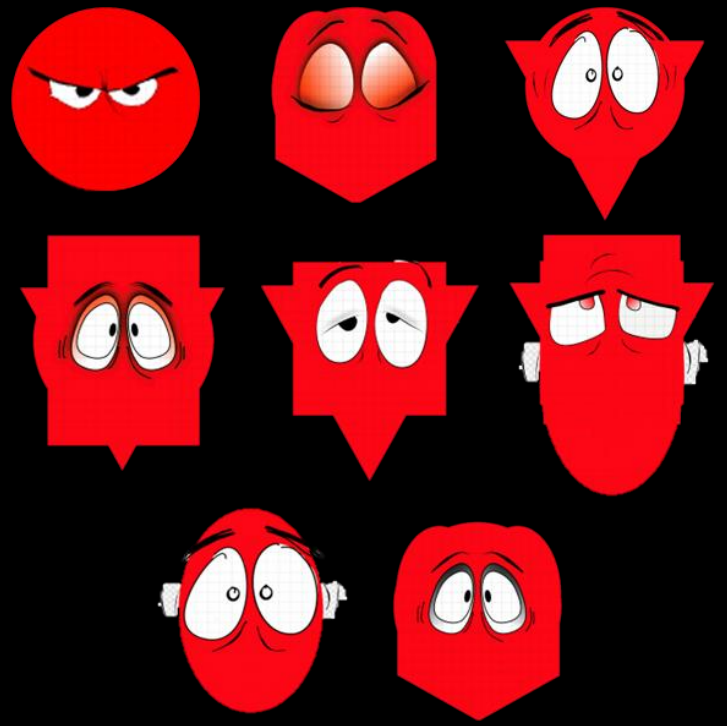
Colour | Facial shape | Hairstyle | Eyebrows | Lips | Nose | Cheeks | Eyes | ears



The Facial Shapes



Demonstration screenshots



Owing to the oversaturation of comparable generative ART NFTs at that time, I opted to discontinue this project and redirected my focus towards envisioning my next endeavor within the realm of Augmented Reality (AR)."

3D Sculpting and Festive Decorations

Digital ART

During my tenure as the Head of the Art Club and as a Core Cultural Committee member at my college, I led numerous events and multidisciplinary teams. Here are some of my notable works:

Photography, Paintings & Apparel Design