# **Abstract:** Science and Engineering Fair of Houston

**3498**

## MIC Vision

Lazaro Castro

Harmony Public Schools - South District/Harmony Science Academy-Houston

**Category:**

Software Design

MIC Vision is open-source software that calculates Minimum Inhibitory Concentration (MIC) from smartphone photographs of 96-well XTT assays, providing an accessible alternative to spectrophotometers costing $2,000-15,000. The analysis pipeline includes image preprocessing, well segmentation, RGB/HSV color extraction, viability normalization, and MIC calculation via isotonic regression and four-parameter logistic curve fitting. Code was developed using OpenAI GPT-5, Anthropic Claude Sonnet 4.5 and Opus 4.5 as generation assistants. For images with geometric distortion where automated grid detection fails, OpenAI GPT 5.2 and Gemini 3 Pro Preview's multimodal capabilities were used to manually annotate well positions with circle overlays. These annotated images were then processed by the Python pipeline, successfully extracting color intensity values and calculating MIC estimates (6.25 µg/mL for test compounds). This demonstrates a hybrid human-AI workflow where multimodal LLMs compensate for algorithmic limitations. Current limitations include incomplete well detection in high-saturation regions and sensitivity to imaging conditions. Future work will integrate LLM API for automated well annotation, enabling end-to-end processing of non-standardized plate photographs without manual intervention. Additional improvements include standardized imaging protocols and adaptive sampling algorithms for variable lighting conditions.

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# **Abstract:** Science and Engineering Fair of Houston

**3499**

**Category:**

Software Design

## Utilizing Grad-CAM Based Training Loss and Self-Attention for Kidney Cancer

Rishabh Bathala, Reyansh Arora, Sahisnu Adhikari

Houston ISD/Carnegie Vanguard HS

Clinical adoption of AI is limited by one ethical problem: high accuracy is not enough if physicians cannot tell whether a model is using medically valid evidence. Popular explainability methods like Grad-CAM, Guided Grad-CAM, and Grad-CAM++ generate heatmaps after training, but they do not influence what the network learns.This leaves a safety gap where a system can appear reliable while depending on external cues. This project uses Tensorflow and introduces a kidney tumor detector based on images from CT KIDNEY DATASET: Normal-Cyst-Tumor and Stone. Instead of adding interpretation later, we calculate Grad-CAM heatmaps during every training iteration and use them as part of the loss function. The model receives gradient feedback not only for classification accuracy but also for the quality of its explanations. We penalize scattered attention patterns and reward focused activations through three complementary metrics: We add an entropy term to the loss that encourages the model to concentrate attention on specific regions rather than distributing it across the entire image. We measure the spatial extent of the heatmap and penalize models that activate large portions of the image, forcing more selective feature usage. We compute the variance-to-mean ratio of activation intensities, rewarding models that produce sharp peaks of attention rather than weak activations. A model trained with tumor-focused Grad-CAM loss cannot "cheat", it must learn genuine tumor morphology, texture, and boundary characteristics to minimize its loss. This creates inherently safer, more generalizable models suitable for real-world clinical deployment across different hospitals, scanners, and patient populations.

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# **Abstract:** Science and Engineering Fair of Houston

**3500**

**Category:** Software Design

## Enhanced Cardiovascular Disease Diagnosis from ECG and Chest X-ray data: A Multimodal Machine Learning model

Shriram Sandilya Garimella

Katy ISD/Seven Lakes - HS

Cardiovascular diseases (CVD) are a group of diseases involving heart and blood vessels and have the highest rate of incidence and mortality rate in the USA and worldwide. Early detection of CVDs offers improved prognosis. Electrocardiograms (ECG) are easy and noninvasive procedures that are widely used for early detection and prevention of CVDs. However, these single modality traditional methods have reduced accuracy requiring significant time and expertise resulting in poor diagnoses. Modern technologies such as artificial intelligence and machine learning offer promising solutions by integrating multimodality data for enhanced diagnostic precision. Here, we propose to employ a multi modal machine learning framework by integrating data from ECG and chest X ray, another easy, convenient and non- invasive diagnostic procedure. For this purpose, a publicly available ECG and Chest X ray imaging data from a study consisting of approximately 10,000 deidentified and anonymous patients was used. Machine Learning model was first trained and then tested to achieve significant accuracy in predicting CVD. This multimodality machine learning CVD predicting model offers enhanced patient outcomes and reduced healthcare costs.

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# **Abstract:** Science and Engineering Fair of Houston

**3501**

## Testing AI Safety Methods on AI Chatbots' Usefulness and Safety

Ngoc Nguyen

Conroe ISD /AST: Academy of Science and Technology

**Category:**

Software Design

As artificial intelligence becomes increasingly integrated into modern society, the challenge of ensuring that AI chatbots are both safe and useful has become increasingly critical. This study tests how three artificial intelligence safety methods - prompt filtering, system prompt guardrails, and post-generation refusal behavior- affect the safety performance and practical usefulness of an AI chatbot. This study used a locally run, more recently released, guarded, open-source language model trained on a basic dataset. The experiment evaluated 300+ prompts, deemed safe, ambiguous, and unsafe, across multiple categories, including illegal activities, fraud, violence, privacy harm, economic harm, cyber harm, and child safety. Each safety technique was tested independently, and results were measured using safety and usefulness metrics. This project aims to identify the performance of safety methods in dealing with edge cases that are evident in real-life applications of these models in organizations, and how each method influences the model's overall ability to provide helpful and accurate responses. The results of this project showed that, by stacking safety methods, the unsafe levels decreased by around 74 percent, with a trade-off in usefulness at around 16 percent. By comparing strengths, limitations, and trade-offs across safety techniques, this research contributes to the understanding of how different safety strategies affect the balance between a chatbot's safety and usefulness. The results of this project could ultimately help future development of AI chatbots and tools that provide safe, high-quality, and reliable performances.

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# **Abstract:** Science and Engineering Fair of Houston

## 3502

**Category:**

Software Design

## Creating and Testing the Accuracy of an Application to Prevent Sugar Overconsumption in Foods Using Optical Character Recognition Technology

Dhruv Shah

Conroe ISD /AST: Academy of Science and Technology

In today's dietary environment, sugars are a hidden contributor to health risks. 15% of the American population is affected by type 2 diabetes, and sugar-sweetened beverages increase this chance by 25%. Current solutions rely on self-reported data, introducing bias and user inconvenience. Using grocery receipts and optical character recognition (OCR) technology, a system that scans text from images for analysis, provides a solution to this problem. This project involves the creation and testing of an application that uses OCR, to scan grocery receipts, raising awareness through visual representation for long term changes to shopping habits. The application was created using Python programming, the Flask web development framework, and the Veryfi OCR, as well as MySQL Databases. The application was tested by uploading 50 Walmart receipts to the software and collecting results. These results were compared with a dataset from USDA via statistical testing. A t-test failed to prove a significant difference within the datasets, TOST supported that the software as accurate with only 3 receipts to be considered "inaccurate," but solely due to improper image quality, an issue that, once fixed through image preprocessing, would raise accuracy to 100%. The MAE showed an average difference of 26 grams, but the RMSE showed this number was from outliers only and not constant error. Overall, the use of OCR serves as a reliable and scalable method to prevent sugar overconsumption. Future improvements include implementing image preprocessing to reduce product misinterpretation and expanding the product database to support potential commercial use.

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# **Abstract:** Science and Engineering Fair of Houston

**3503**

## AI-Driven Predictive Modeling for Stock Market Trends: Analyzing Machine Learning Accuracy in Investing

Raheel Mansury

Conroe ISD /TWCP High School

**Category:**

Software Design

This project focuses on developing and evaluating a functional AI-based stock prediction model that uses real-world financial data and modern machine learning methods. Its main objective is to combine historical stock price information with sentiment analysis of financial news headlines in order to improve the accuracy of forecasting future market trends. The model will be implemented in Python and will incorporate several machine learning algorithms, including linear regression, decision trees, and neural networks, which allows for comparison across different predictive techniques. To process the textual sentiment within news data, the project will use Meta Llama 3 through the Ollama platform, enabling the extraction of meaningful patterns from large collections of financial text. The scientific importance of this research comes from its examination of the connection between artificial intelligence and financial forecasting, a field that continues to expand in both academic and practical relevance. By showing how AI methods can strengthen traditional market analysis, this work has the potential to support more informed investment strategies and contribute to broader efforts to improve financial literacy and decision-making in society.

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# **Abstract:** Science and Engineering Fair of Houston

**3504**

## Mobile Pollution Mapping System

Savant Williams, Kevin Jaime

Harmony Public Schools - North District/Harmony School of Advancement

**Category:**

Software Design

Air quality affects people's health and the environment. Air quality monitors are used to measure pollution in the air, but different types of monitors collect data in different ways. Stationary monitors stay in one place, while portable and wearable monitors move with people but usually only measure air near the ground or by the time the person is alerted, they're already triggered. This project tests whether a drone-mounted air quality monitor can collect better air quality data than stationary and wearable monitors. A sensor will be placed inside a drone to measure air quality at different locations and heights. The data collected by the drone will then be compared to data from a stationary monitor and a wearable monitor. The results will hopefully show that the drone can detect more differences in air quality because it can move to many areas and fly at different heights. This project shows how mobile air quality monitoring could help improve understanding of air pollution.

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# **Abstract:** Science and Engineering Fair of Houston

**3505**

## How Does Model Architecture Effect Detecting Skin Cancer

Luke Yamokoski

Clear Creek ISD /Clear Lake High School

**Category:**

Software Design

This project investigates how deep neural network (DNN) architecture and transfer learning affects the accuracy and the sensitivity of an AI designed to classify dermoscopic images of skin lesions as benign or malignant. Four pretrained architectures, DenseNet121, ResNet50, MobileNetV2, and EfficientNet-B0 were tested. Each model was fine-tuned on the publicly available HAM10000 dataset using a constant learning rate of "1e-4." with three trial runs for each configuration to ensure reliability. Model performance was evaluated using AUC, Specificity, and Sensitivity. An ANOVA on the AUC scores showed a significant difference between the model architectures. A post-hoc analysis showed that DenseNet121 achieved the highest mean AUC but was still statistically tied in overall performance with ResNet50 and MobileNetV2. Another ANOVA on the Sensitivity revealed that DenseNet121 significantly outperformed both ResNet50 and MobileNetV2 in correctly identifying malignant lesions. With the data provided by the ANOVA's, it can be concluded that DenseNet121 offered the best balance of overall performance. This supports my hypothesis that a more complex architecture is necessary to optimize performance in classifying dermoscopic images of skin lesions as benign or malignant.

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# **Abstract:** Science and Engineering Fair of Houston

**3506**

## Software Analysis of Hypercholesterolemia (high LDL-C STATIN)- HMGR - Hydroxymethylglutaryl-CoA reductase- 3CCW

Gyansai Sigireddi, Aliyaan Damani

Harmony Public Schools - South District/Harmony School of Innovation - Sugar land

**Category:**

Software Design

The main part of our project is showing our experiments through software. We are studying how HMGR, an important enzyme in cholesterol metabolism, is affected by various inhibitors. By testing these molecules, our team aims to demonstrate different approaches to treating hypocholesterolemia, the main condition linked to HMGR. Using coding software, we plan to create clear visuals that show how protein inhibitors can alter cholesterol-related molecules, both positively and negatively. In the end, our goal is to use these results to point toward possible solutions for fighting hypocholesterolemia and create a visual representation of this process

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# **Abstract:** Science and Engineering Fair of Houston

**3507**

## Lexibot Language

Ibzan Morel, Dhruv Patel

Harmony Public Schools - South District/Harmony Science Academy - Beaumont

**Category:**

Software Design

Lexibot is an AI powered chat bot website that is designed to help with language learning through an interactive platform that is easy for students to use. We developed this project using a combination of JavaScript and Python, while also using a Google HuggingFace model on the backend to generate translation on the fly. Our chat bot is capable of teaching a vast array of global languages, including English, Spanish, Turkish, Hindi, French, and Chinese, among many others.

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# **Abstract:** Science and Engineering Fair of Houston

## 3508

## IoT Smart Fish Feeder

Yan Cerritos

Harmony Public Schools - North District/Harmony School of Advancement

**Category:**

Software Design

This project created an IoT□controlled fish feeder designed to improve feeding consistency for aquarium owners. An ESP32 microcontroller operated a servo to dispense food on a schedule or through remote commands. A food□level sensor provided refill alerts. The system was tested for timing accuracy, portion consistency, and responsiveness. Results showed reliable scheduled feeding, accurate portions, and successful remote operation. This demonstrates how simple IoT systems can reduce human error and improve aquarium care.

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# **Abstract:** Science and Engineering Fair of Houston

## 3509

**Category:**

Software Design

### A.C.H.O.O: Allergic Condition Health Observation & Oracle — An Interpretable Deep Learning Platform for Early-Onset Classification of Pollen Allergies in Children versus Viral Respiratory Infections

Arjun Diwakar, Sarah Castro, Parth Zanwar

Cy-Fair ISD/Cypress Ranch - HS

In current pediatric respiratory diagnostics, early-onset seasonal pollen allergies and viral respiratory infections in youth prove a persistent challenge due to substantial symptom overlap during initial disease progression. Despite separate pathophysiologies, both conditions output near-identical systemic conditions, resulting in unnecessary reliance on laboratory-based clinical testing, which may lead to further diagnostic ambiguity. Although these testing techniques provide aid, it is often costly or inaccessible during early-stage development, underscoring the need for easily-accessible, computationally driven screening methodologies. In this research, A.C.H.O.O is developed as an interpretable, software-based machine-learning system designed to distinguish early-onset pollen allergies from viral respiratory infections in pediatric populations using symptom patterns, demographic factors, and environmental weather data. By analyzing symptomatic factors, our system leverages machine learning architecture to build data patterns paired with autonomous optimization. This interpretability-centric design, matched with continuous cross-reference with rotating, prevalent illnesses & allergens, prioritizes comparative clinical relevance. A.C.H.O.O is evaluated through comparative analysis against baseline statistical and machine-learning industry techniques and validated using cross-validation on benchmark sets of simulated or publicly available datasets containing symptoms & diagnosis. Performance metrics demonstrate that A.C.H.O.O achieves an 80% yield towards classification accuracy while maintaining computational efficiency and cost-effectiveness. These results indicate that interpretable systems software can effectively supplement early pediatric respiratory assessment and support real, clinical decision-making. This work demonstrates the broader potential of machine-learning systems to enhance reliability in pediatric health decision-support technologies.

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# **Abstract:** Science and Engineering Fair of Houston

**3510**

## Cyberbullying Suicide Risk Detection Using Multimodal Deep Learning and Explainable AI

Rohan Ghosh

Tomball ISD/Tomball HS

**Category:**

Software Design

This project explores the use of artificial intelligence (AI) to detect emotional states and potential signs of bullying or distress in text-based conversations. The model uses a hybrid deep learning architecture combining RoBERTa and a bidirectional LSTM (BiLSTM) to analyze both the content and the flow of conversations. RoBERTa provides deep contextual understanding of each message, while the BiLSTM layer captures sequential patterns and emotional shifts across multiple turns in dialogue. A key innovation of this approach is the treatment of silence as information. Messages that are read without response are represented by a special token ("_"), allowing the model to learn how inactivity or lack of engagement can carry emotional meaning. The system evaluates the tone, emotional intensity, and contextual progression of a conversation to assess its overall risk level, distinguishing between temporary conflict, potential bullying, and indicators of emotional distress. By combining transformer-based language modeling with sequence-aware reasoning, this hybrid framework demonstrates how AI can support early detection of negative online interactions and provide insight into emotional well-being in digital communication environments. Furthermore, the training dataset uses over 23,000 samples of data, collected from a public database, to train and test the loss of the model. Over hours of training, a developed model is created. This can be used in many ways, and it can be implemented into real world use. For example, the development of a bot to scan and alert people for suicidal activity can be created and implemented into real-life, active chats.

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# **Abstract:** Science and Engineering Fair of Houston

## 3511

**Category:**

Software Design

## Designing a Quantum Computing Algorithm to Simulate Interactions Between Cancer-Mutated Proteins and Anti-Tumor Drugs

Maaz Kattangere

Conroe ISD /AST: Academy of Science and Technology

Cancer is one of the most devastating diseases of our time, and arises from genetic changes in a human cell that produce abnormal proteins and cause uncontrollable cell division. Treatments like chemotherapy rely on treatment drugs to bind to these proteins. However, drug discovery processes are lengthy and costly, with companies spending billions of dollars over decades only for most candidates to fail during clinical trials. Drug simulation technologies could help mitigate such issues. However, today's classical drug simulation technologies struggle to scale to the complex molecular behaviors associated with intricate protein-drug systems. This research proposes a hybrid quantum-classical framework to simulate such cancer treatments. Due to limited quantum compute power today, only the most chemically reactive sites of the protein and drug are compiled, reducing the problem size, and making the framework feasible. These regions are then simulated using a Variational Quantum Eigensolver (VQE) which encodes each particle in the protein and drug into its processing units to directly simulate molecular interactions in real time. This framework was evaluated in a real-world case study: the epidermal growth factor receptor (EGFR, a common cancer-induced protein) and Gefitinib (an FDA-approved drug). The simulated binding energies from the framework were compared with real world laboratory results. Statistical analysis with a one-pair t-test demonstrated a statistically significant agreement between the simulated results and actual lab tested results of binding energies between the protein and drug. This framework demonstrates a proof-of-concept of the potential of quantum technologies in enhancing drug discovery processes.

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# **Abstract:** Science and Engineering Fair of Houston

**3512**

## Using Machine Learning and Automated Systems to Detect and Report Macroers in Online Video Games

Bruce Shu

Conroe ISD /AST: Academy of Science and Technology

**Category:**

Software Design

This project investigates the use of machine learning and automated analysis systems to detect macroers, which are players who use automated scripts to perform precise, repetitive actions in online video games. Macros generate highly consistent movement and timing patterns that differ from natural human behavior, making them suitable for data-driven detection. Traditional detection methods, such as looking at server logs, work but have a high false positive rate, which is the amount of innocent players being incorrectly flagged as macroers. Player movement logs are collected from both human inputs and macro-generated actions, then segmented and analyzed to extract features such as velocity, path smoothness, and timing intervals. Machine learning models, including Random Forests and LSTM networks, are trained to distinguish human behavior from automated patterns. Model performance is evaluated using precision, recall, F1-score, and confusion matrices, with a focus on minimizing false positives to protect legitimate players. The results demonstrate the potential for a reliable and scalable system capable of flagging suspected macro use for further review, supporting fairness, integrity, and long-term player engagement in online gaming environments.

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# **Abstract:** Science and Engineering Fair of Houston

**3513**

## Object Centric Reinforcement Learning for Sim-to-Real Dexterous Manipulation

May Espinola

Katy ISD/Tompkins - HS

**Category:**

Software Design

Robotic manipulation of hazardous or sensitive objects is essential in laboratory, industrial, and remote environments, but remains challenging due to object variability and safety constraints. While teleoperation enables human control in these settings, it requires continuous attention and limits scalability. This project presents an object -centric reinforcement learning framework that enables a robot to learn manipulation tasks from a short human demonstration and execute them autonomously. Using NVIDIA Isaac Sim, the system extracts object-level task objectives and physical outcomes rather than explicitly imitating joint or trajectory motions, allowing the policy to reason about desired object behavior. Reinforcement learning then refines the policy under randomized physical conditions, training robustness to variations in object shape, mass, friction, and contact dynamics. The learned policy is evaluated on multiple object-handling tasks involving previously unseen object variations. Performance is measured using task success rate, completion time, safety violations, and required human intervention. Results show that the object-centric approach improves adaptability to novel objects while reducing human workload compared to teleoperation-only control. By centering learning on object-level task outcomes and leveraging large-scale simulation rather than extensive real-world data collection, this approach enables the generation of massive, diverse object-interaction data, improving accuracy and adaptability while reducing cost and risk, with applications in hazardous material handling, laboratory automation, and remote scientific operations.

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# **Abstract:** Science and Engineering Fair of Houston

## 3514

## Heartball AI

**Category:**

Software Design

Joshua Li

Private/The Village School

Special education teachers are required to conduct assessments, document progress, and design individualized instructional plans, but these tasks are often handled using disconnected tools and manual workflows. This fragmentation increases workload and can lead to inconsistencies between assessment results and instructional planning. The purpose of this project was to engineer a software system that integrates assessment, reporting, and instructional planning into a single, coherent workflow. The system was designed as a web-based platform that accepts structured, standardized assessment inputs and automatically generates domain-level visual reports and editable instructional plans aligned to measured student profiles. Machine learning and natural language generation techniques were used to produce draft summaries and instructional content based on predefined assessment domains. All generated outputs require human review and editing, ensuring that professional judgment remains in control. The system was developed and evaluated using simulated and anonymized data created for testing purposes. Evaluation focused on verifying accurate data processing, consistency of visual reports, and alignment between assessment inputs and generated instructional drafts. No human participants, animals, or hazardous materials were involved in this project. This project demonstrates how structured educational data combined with machine learning can reduce workflow fragmentation and support more consistent instructional planning in special education settings.

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# **Abstract:** Science and Engineering Fair of Houston

**3515**

## Reducing Food Waste by Using AI for a More Sustainable Society

Sneha Kibey

Conroe ISD /ACES: Academy for Careers in Engineering and Scien

**Category:**

Software Design

Food waste constitutes a critical global environmental and economic problem. Approximately 2 billion metric tons, or nearly 30% of all food produced worldwide each year, is discarded, resulting in an estimated annual economic loss of $160 billion USD. When landfilled, wasted food undergoes anaerobic decomposition, producing approximately 3 billion metric tons of greenhouse gas emissions annually, predominantly methane. According to the United Nations Environment Programme's 2021 Food Waste Index Report, households account for 61% of global food waste, indicating that meaningful mitigation requires scalable household-level solutions. Artificial intelligence (AI) has demonstrated effectiveness in reducing food waste in commercial food systems through predictive analytics and inventory optimization; however, comparable consumer-facing systems remain limited. This gap highlights the need for accessible software systems capable of supporting real-time, household decision-making. This project presents the design, implementation, and evaluation of an image-based AI system deployed as a smartphone application to detect food spoilage in common household foods. The system integrates image preprocessing, machine learning–based classification, and user-facing decision support within a unified software pipeline. Model performance was evaluated using classification accuracy and inference latency, demonstrating the feasibility of real-time spoilage detection on consumer-grade devices. By translating environmental sustainability objectives into a deployable systems software solution, this research demonstrates how consumer-accessible AI can influence food management behavior. The results suggest that image-based spoilage detection systems have the potential to reduce household food waste, decrease associated greenhouse gas emissions, and improve resource efficiency at scale.

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# **Abstract:** Science and Engineering Fair of Houston

**3516**

## HAND TREMOR DETECTION

**Category:**

Software Design

Jasse Therese Alob

Harmony Public Schools - North District/Harmony School of Advancement

Tremors in the hand may be symptoms of some neurologic and stress problems, but these also cannot be observed manually, and some technological aid is required for their identification. This project describes the design of a real-time hand tremor notifier using Python and OpenCV. A camera is deployed to record hand movement, and computer vision concepts are applied to analyze these hand motions to determine their patterns. Once the hand movement crosses a predefined threshold, a sound alarm and an email notification are generated. The aim of this project is to establish the use of computer programming and computer vision in real-world health awareness applications. This project is in no way a medical diagnostic application, as it is simply a form of awareness and educational technology. Testing has revealed that it is possible for the application to detect a noticeable tremor more accurately in stable lighting and a steady camera position. This project is a means of showcasing the use of technology in the pursuit of health awareness and the use of computer science and engineering skills in everyday life.

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# **Abstract:** Science and Engineering Fair of Houston

**3517**

## Rebuilding Our Future - Alphabet Adventures II

Dhyean Dileepkumar Remya, Nykolas Greene, Enoch Adebiyi

Fort Bend ISD /Willowridge High School

**Category:**

Software Design

Fourty-nine and forty-four. Those numbers represent the percentage of students who did not meet grade level and did not approach grade level on the 2025 STARR exam. The implication of this number is that students' language skills are getting worse and remedying this issue starts with Pre-K. Although starting at a higher grade level might seem like the best option, starting at the lowest grade level of Pre-K is the best option due to the Mathew Effect. This rule says that when someone starts something earlier then that will allow them to get a wider gap than someone who started later in time. This is why when we created Alphabet Adventures, we intended to give students in Pre-K a fun and low-cost method to build up their language skills so even students that are economically disadvantaged do not fall behind on their English. To do this we intend to build on the application that we started last year by creating more games as well as a website. To do this we used; our laptops, Visual Studio Code, the Unity game engine, Py.Game, as well as the GIMP 3 photo editor for sprite creation. We continue to work on the application however we have not been able to test it yet as we hope to put out a product that would meet the expectations of both the parents of students using the app and the TEA TEKS.

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[X] yes [ ] no

# **Abstract:** Science and Engineering Fair of Houston

**3518**

## Night Light

Teslim Kuku

Harmony Public Schools - South District/Harmony Science Academy-Houston

**Category:**

Software Design

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☐ yes ☐ no

# **Abstract:** Science and Engineering Fair of Houston

**3519**

## Predicting Formula One Pit Stops Through Machine Learning

**Category:**

Software Design

Needah Memon

Clear Creek ISD /Clear Lake High School

Machine learning (ML) has become an increasingly valuable tool in motorsports, where milliseconds determine race outcomes and pit stop timing plays a critical strategic role. This project investigates whether publicly available Formula 1 lap-level racing data can be used to predict pit stop occurrence using three ML models: logistic regression (LR), decision tree (DT), and random forest (RF). The hypotheses predicted that all models would outperform a majority-class baseline, that the random forest would achieve the strongest overall performance, and that tire age and lap time delta would be the most influential predictors. Datasets from the 2022–2024 Formula 1 seasons were merged and engineered to include variables such as lap time delta, stint length, tire age, and race position. Models were evaluated using accuracy, recall, F1 score, and specificity to account for the severe imbalance between pit stop and non-pit-stop laps. Results showed that logistic regression achieved high accuracy but failed to identify pit stops, confirming that linear models struggle with this task. The decision tree and random forest demonstrated substantially higher recall and F1 scores, with the random forest performing best overall, supporting the second hypothesis. Feature importance results showed that lap time delta was the strongest predictor, followed by stint length and tire age, partially supporting the third hypothesis. These findings indicate that sudden performance changes and cumulative tire wear are key signals of pit stop decisions. Although limited by the absence of proprietary telemetry and tire compound data, the study demonstrates that pit stop prediction is feasible using public datasets.

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# **Abstract:** Science and Engineering Fair of Houston

**3520**

## Making a calculator with Python

Christopher Lassen

Charter/SST - Champions College Prep - HS

**Category:**

Software Design

For my science project, I created a presentation explaining that I created a calculator in Python and describes my process creating it. I also explain the history of calculators and how they work.

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# **Abstract:** Science and Engineering Fair of Houston

**3521**

**Category:**

Software Design

## Information Diet App: A Multimodal AI System Leveraging Language Models for Real-Time Browser-Based Credibility, Bias, and Synthetic Media Detection

Tanay Joshi

Conroe ISD /TWHS: The Woodlands High School

Misinformation and AI-generated media present increasing challenges to information credibility in digital news environments. This project investigates whether real-time feedback can improve news consumption behavior and whether AI-generated images can be accurately detected using local artificial intelligence tools. A Chrome browser extension and web dashboard were developed to analyze news articles and images in real time. The system uses a locally run natural language processing model to score article quality and an AI-image detection model to identify AI-generated images. All processing occurs on-device to preserve user privacy. For the first experiment, four family participants completed two six-day news-browsing periods. During each day, participants spent 15 minutes reading news and selected four articles. In the control phase, the extension was disabled. In the treatment phase, article quality scores were displayed before reading. Article URLs were recorded and analyzed. A paired t-test showed a statistically significant increase in average article quality during the treatment phase. The second experiment evaluated deepfake detection accuracy using a dataset of 100 real and AI-generated images. The detection model achieved an accuracy exceeding an 80% benchmark, supporting the hypothesis. Results suggest that real-time feedback can positively influence news selection and that local AI tools can effectively detect AI-generated media.

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# **Abstract:** Science and Engineering Fair of Houston

**3522**

**Category:**

Software Design

## Democratizing High-Quality Open-Source Large Language Models through Optimal Iterative Refinement Pipelines

Anushka Polapally

Katy ISD/Tompkins - HS

Large language models (LLMs) have become widely used for tasks such as translation, writing assistance, and code generation, with platforms like ChatGPT growing from 300 million users in 2022 to a projected 1 billion in 2025. Closed-source models dominate in performance but lack transparency, restricting use in privacy-sensitive domains. However, open-source LLMs—while enabling local deployment and full data control—typically lag in accuracy, especially in verification and correction tasks crucial for reliable deployment. This project investigates whether iterative refinement pipelines can improve open-source LLM performance without the need for retraining. It was hypothesized that accuracy would increase when models were arranged in structured loops, where one model verifies and, if necessary, corrects the outputs of another. The independent variables were pipeline design, including verifier–generator pairings and the number of refinement cycles. The dependent variable was accuracy on a handcrafted dataset. Limitations included the relatively small size of the dataset and the focus on only three models due to computational constraints. Preliminary results support the hypothesis. Accuracy improved significantly compared to single-pass model outputs, with the best performance achieved at moderate cycle lengths. Too many iterations produced diminishing returns, suggesting that refinement must be carefully balanced. These findings indicate that iterative refinement can reduce error rates, increase reliability, and avoid the high financial and computational burden of retraining larger models.

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# **Abstract:** Science and Engineering Fair of Houston

**3523**

## FlyTwin: A Connectome-Constrained Digital Twin for Embodied Drosophila Behavior

Aarav Sinha

Katy ISD/Tompkins - HS

**Category:**

Software Design

Most neuroscience and robotics models either simulate bodies without real brains or model brains without embodied behavior; FlyTwin bridges that gap by creating a brain-in-the-loop digital organism that reproduces fly-like behavior in a closed-loop physics simulation. This project introduces FlyTwin, a digital twin that links multisensory inputs, connectome-based spiking neural dynamics, and embodied action inside MuJoCo. I engineered an end-to-end prototype: a MuJoCo fly environment with a standardized task battery, plus a spiking brain emulation wired from Drosophila connectome resources (FlyWire). A sensory encoder converts vision, odor, taste, and touch-like events into neural stimulation, and a decoder plus behavior selection layer gates descending-neuron activity into motor commands and context-dependent switching so behavior emerges from spiking dynamics rather than scripted rules or a black-box policy. The environment elicits navigation, obstacle avoidance, grooming-trigger switching, and foraging. An automated evaluation harness runs repeated randomized trials, logs sensory streams, neural activity, motor commands, and trajectories, and computes quantitative metrics. Across 100 trials (25 per task), overall success was ~85% (navigation 89%, obstacle 83%, grooming-switch 78%, foraging 90%). Mean time to goal (success, mean +/- SD) was 6.6 +/- 1.8, 8.0 +/- 2.3, 9.3 +/- 2.7, and 7.4 +/- 2.1, respectively. Collisions and instability remained low (mean per trial: 0.17, 0.55, 0.33, 0.24) and control was stable (heading jitter, deg RMS: 7.2, 9.0, 8.5, 7.9). Compared with a size-matched RNN controller, and with ablations (shuffled connectivity, reduced sensory inputs), the connectome-based controller achieved better task performance and faster completion. FlyTwin provides an end-to-end, testable platform that makes connectomes->dynamics->behavior measurable, enabling interpretable bio-inspired control and a scalable framework for digital organism neuroscience.

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# **Abstract:** Science and Engineering Fair of Houston

**3524**

**Category:**

Software Design

## Reducing Dangerous Traffic Situations: A Real-Time Adaptive Traffic Safety System Based on Collision Risk Dynamics

Krishna Harish

Fort Bend ISD /Elkins High School

Dangerous traffic situations often come from busy highways, where unexpected speed changes disturb the flow of vehicles, thus increasing the risk of close-call crashes as well as rear-end collisions. These situations usually happen without accidents or visible causes, making it hard for drivers to anticipate and lowering the effectiveness of reactive traffic safety measures. As the volume of traffic continues to increase and real-time sensing technologies become more widespread, there is more opportunity than ever to improve highway safety with proactive, automated intervention. This project presents a real-time adaptive highway safety system that is designed to reduce dangerous traffic situations before they escalate. The system uses a four-layer architecture that continuously monitors vehicle spacing and speed, assesses risk using time-to-collision calculations, selects an appropriate safety response, and applies real-time speed adjustments to maintain stable traffic flow. The system was tested in a computer simulation of a 1000-meter highway segment under low, medium, and high traffic conditions. Compared to a baseline case without any intervention, the adaptive system reduced near-collision events significantly, and achieved over an 80 percent reduction in high traffic density, where most accidents happen. The exact same software architecture and control algorithms used in this simulation can be deployed on real traffic data streams from connected vehicles or roadside sensors, enabling real-time detection of unstable traffic conditions and automated speed control using the validated system.

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# **Abstract:** Science and Engineering Fair of Houston

**3525**

## Using Python to Simulate the Effects of Natural Resource Management Strategies

Sam Perkey

Conroe ISD /AST: Academy of Science and Technology

**Category:**

Software Design

As time goes on, the resources available to human society will begin to dwindle. Due to a combination of increasing global population and the slow renewal rate of many necessary resources, important resources are slowly becoming scarcer and scarcer. To combat this, it is important to first attempt to estimate what future conditions will be. This project aimed to create a general Python model to simulate the impacts and usefulness of different resource management strategies. To do so, a mathematical model was constructed to be used as a basis for the Python program. From there, the model was fully developed in Python, allowing for a user to modify all variables they saw fit before testing the model over a designated timeframe. The model's design allows for easy modification and expansion, and the model prioritizes a lack of units or specialization so as to remain flexible for many purposes. In order to verify the efficacy of the model, data on yearly oil usage in the US was used to create a resource preset. This preset was then run in the model three times in conditions replicating those in the United States during the given time period (2010-2020). The model's output was then compared against the validation dataset, and the margin of error was calculated to be approximately 5% in both population growth and resource usage estimates. Overall, the final model demonstrates verifiable accuracy in conjunction with ease of modification and use, achieving all project goals and allowing for continued novel expansion.

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# **Abstract:** Science and Engineering Fair of Houston

**3526**

## OmniTiles - A Universal Tile Map File Converter

Caden Smithwick

Conroe ISD /ASHP: Academy for Science and Health Prof

**Category:**

Software Design

Tile maps are tools used in two dimensional game development to create and represent levels and game worlds from one base tile set image file. Tile maps are widely utilized and are implemented in several different game engines, each of which use a different file type. Despite the prevalence of tile maps and the widely accepted importance of file conversion for computer science as a whole, there has been no official research done on file conversion of tile maps, and the programs that do exist are limited in their scope and features. So, in order to assess how similar different tile map file types are - and thus how easily they can be converted without data loss - as well as to create a practical solution to this problem, a program titled OmniTiles was constructed. This program converts between some of the most commonly used tile map file types, including TMX, TSCN, JSON, unitypackage, and CSV. Then, the program was tested using a round trip file format conversion of three benchmark tile maps containing a large variety of features and data from each file format, and examined how much of this data was lost from each conversion. After testing, it was concluded that while basic conversion implementation was achieved, multiple important data sections are being lost, such as object definitions, tile properties, and collision mappings. This means that while interoperability can be achieved between these file types, more research needs to be done to improve this program and achieve interoperability.

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# **Abstract:** Science and Engineering Fair of Houston

**3527**

## OncoGAT- A Novel Multimodal Graph Attention Network for Precision Oncology

Srikar Karri

Cypress Fairbanks ISD/Bridgeland - HS

**Category:**

Software Design

Precision oncology requires integration of hetero-geneous multi-omics data to enable personalized diagnosis, prognosis, and treatment selection. Current methods often treat molecular features independently, limiting accuracy and interpretability. In this study, we propose a multimodal Graph Attention Network (GAT) framework that models patients as nodes in molecular similarity graphs constructed from genomics, transcriptomics, methylation, mutations and copy number variation data. LASSO regression was applied for biomarker selection, identifying up to 500 key features across omics layers. We evaluated the framework on the METABRIC multi-omics dataset (1,411 patients) and achieved 92.13% accuracy for PAM50subtype classification and a C-index of 0.713 for survival prediction, outperforming baselines by 15 to 20%. Risk stratification into low, medium, and high-risk groups demonstrated statistically significant survival differences ($p < 0.001$). Predicted drug sensitivity patterns aligned with established clinical guidelines, including strong responses to endocrine therapies in Luminal subtypes, HER2-targeted therapies in HER2-enriched tumors, and chemotherapy/immunotherapy in triple-negative cases. To enable clinical translation, we deployed the model as a Streamlit-based decision support application, providing real-time predictions with interactive visualizations and concordance with expert tumor board recommendations. By unifying subtype classification, survival prediction, and treatment personalization in a single interpretable framework, this work advances the implementation of precision medicine in routine oncology practice. Keywords: Precision oncology, graph attention networks, multi-omics integration, breast cancer, LASSO regression, clinical decision support

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# **Abstract:** Science and Engineering Fair of Houston

**3528**

## CyberShield: Detecting cyber threats

Javier Buena, Raphael Okpani, Damauryen Dickson

Fort Bend ISD /Willowridge High School

**Category:**

Software Design

This project focuses on creating computer code that can detect and help prevent phishing emails. Phishing is a common cyberattack where scammers try to trick people into giving away personal information by pretending to be trustworthy sources. The goal of this project was to design a program that can recognize warning signs in emails, such as suspicious links, unusual wording, or fake sender addresses. The code uses a set of rules and pattern□checking methods to decide whether an email is safe or potentially harmful. To test the program, a collection of real and fake emails was used to measure how accurately it could identify phishing attempts. The results showed that the program was able to catch most phishing emails while avoiding many false alarms. This suggests that automated tools like this can help protect users and reduce the risk of falling for online scams.

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check all that apply):

[ ] Human participants [ ] potentially hazardous biological agents

[ ] Vertebrate animals [ ] microorganisms [ ] rDNA [ ] tissue

2. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only.

[X] yes [ ] no

3. I/We worked or used equipment in a regulated research institution or industrial setting.

[X] yes [ ] no

4. This project is a continuation of previous research.

[ ] yes [X] no

5. My display board includes non-published photographs/visual depictions of humans (other than myself):

[ ] yes [X] no

6. I/We hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work.

[X] yes [ ] no