

Abstract: Science and Engineering Fair of Houston

1373

Comparing the Accuracy of AI-Powered & Traditional OCR

Laila Collver

Conroe ISD /McCullough Junior High

Category:

Software Design

Optical Character Recognition (OCR) is widely used to convert images of text into editable digital text. However, OCR is not always completely accurate, especially with handwritten text. This project investigated the accuracy of OCR using AI (ChatGPT, a large language model) and a non-AI engine (Tesseract 3). I hypothesized that ChatGPT would produce higher accuracy for both printed and handwritten text. Text images and handwriting samples were processed by both OCR engines, and Word Error Rate (WER) and Character Error Rate (CER) were calculated. Results showed that ChatGPT achieved 0% CER for text and 15.84% CER for handwriting, while Tesseract 3 achieved 0.15% CER for text and 91.82% CER for handwriting. These findings indicate that AI significantly improves OCR accuracy, particularly for handwriting, supporting my hypothesis.

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- Human participants potentially hazardous biological agents
 Vertebrate animals microorganisms rDNA tissue

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1374

Multimodal AI Combining Chest X-rays and Clinical Data to Diagnose Tuberculosis

Bhavana Thambireddy, Anjali Balne

Conroe ISD /Irons Junior High

Category:

Software Design

Tuberculosis (TB) is a serious lung disease that can be difficult to diagnose using chest X-rays alone, especially in borderline or unclear cases. In this project, two artificial intelligence (AI) models were compared for TB detection: an image-only model that analyzes chest X-ray images and a multimodal model that combines X-ray images with patient metadata, including age and reported symptoms. The purpose of this study was to determine whether the addition of clinical metadata improves diagnostic performance and model confidence. Both models were trained using the same dataset and evaluated using accuracy, precision, recall, confusion matrices, and confidence scores. To better understand how each model made its predictions, Grad-CAM was used to highlight important regions in the X-ray images. In contrast, SHAP was used to measure the influence of metadata features on the multimodal model's decisions. Model performance was analyzed across easy, borderline, and ambiguous cases. The results showed that the multimodal model performed better when image features alone were unclear, indicating that metadata provides useful contextual information. This study demonstrates that combining medical images with clinical data can improve TB detection and increase the transparency and trustworthiness of AI-based diagnostic systems.

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1375

Computational stock buy signal detection and alerts

Daksh Bansal

Conroe ISD /McCullough Junior High

Category:

Software Design

The purpose of this project is to design and test a computer program that identifies stock price support levels using historical data and sends an email alert when a stock reaches that level. The program analyzes past daily stock prices to find repeated low points, which are used to calculate a support level. When the current stock price approaches this level, the system automatically sends an email notification. The results are evaluated by comparing the detected support levels with actual stock prices using tables and graphs. This project demonstrates how data analysis and automation can be combined to recognize patterns in real-world data and provide timely alerts without continuous human monitoring. This project explores the use of mathematical models to analyze and predict stock market behavior. Financial markets generate large amounts of numerical data, including prices, returns, and trading volumes, which can be studied using mathematical and statistical techniques. In this study, historical stock price data is used to identify patterns and trends through models such as moving averages, regression analysis, and probability-based methods. These models help estimate future price movements and assess market risk under different conditions. The project also evaluates the accuracy and limitations of mathematical prediction in the stock market. Since market prices are influenced by uncertainty, human behavior, and external events, no model can predict outcomes with complete certainty. By comparing model predictions with actual market results, this project demonstrates how mathematics can support informed decision-making while highlighting the importance of assumptions, data quality, and risk management in financial forecasting.

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Abstract: Science and Engineering Fair of Houston

1376

Digital Diagnosis: Training AI to Recognize Plant Diseases

David Wong

Conroe ISD /Knox Junior High

Category:

Software Design

The goal of the project was to create an accurate, offline AI system that could classify crop disease to assist farmers in early disease detection. The goal accuracy for the AI model was set at 80%. First, a pre-trained Vision Transformer AI model was adjusted using transfer learning. Next, a crop leaf dataset including 14 crop types and 38 diseases was downloaded from PlantVillage and split into 3 sets, training (38,000 images), validation (14,785 images), and testing (1,500 images). Then, the model was trained for 3 epochs. The final training accuracy ended with 98.2% and the validation accuracy, 95.7%. The model was then tested with the unseen test images to measure classification accuracy. The testing accuracy ended up to be 99.5% surpassing the goal accuracy of 80%. The training data for the epochs was recorded on a line graph, and a bar graph was used to compare the goal, training, and testing accuracy of the AI model. In conclusion, the model successfully exceeded the engineering goal by 19.5%. The final accuracy of 99.5% proves that AI Image Recognition can effectively classify crop disease. The deployment as an offline application means that the AI model can be run without the need of internet. This AI system can provide farmers with a reliable tool for disease detection, and potentially reduce crop loss. Future improvements to this project include mobile accessibility, expanding to additional crop types, and adding alerts for disease outbreaks in the area.

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Abstract: Science and Engineering Fair of Houston

1377

Nothing But the Swish? When Bank Shots Beat It...

Jayden Om Benyei-Anirudhan, Vinicius De Faria
Tomball ISD/Creekside Park JH

Category:

Software Design

We investigated whether bank shots or swish shots are more effective in basketball and how shooting mechanics influence success rates. Many players believe "nothing but net" is always best, but we hypothesized that bank shots might actually be more reliable at certain angles due to the backboard providing a larger effective target area. We tested five middle school basketball players (ages 11-12) shooting from two positions: directly in front of the basket (0°) and at a 45-degree angle. At each position, players attempted both swish shots (aiming directly for the basket) and bank shots (using the backboard) from two different starting positions: chest level and overhead. Each player completed 48 shots while we recorded success rates, launch angles, entry angles, and ball spin using high-speed video analysis. Our results revealed that bank shots were significantly more successful than swish shots at the 45° angle, but swish shots performed better at 0°. We also discovered that overhead starting positions produced higher launch angles (averaging 52°) compared to chest-level starts (averaging 44°), which correlated with improved success rates for swish shots. Interestingly, shots with medium backspin showed the highest overall success rate (62%) compared to low or high spin. These findings suggest that the "best" shot type depends on court position and shooting mechanics. Our research provides practical guidance for youth basketball players: use bank shots when shooting from angles greater than 30°, but stick with direct shots when straight-on. We also created a simple decision guide that coaches can use to help players choose optimal shot techniques based on their position on the court. This project combines physics principles (projectile motion, angles of incidence) with biomechanical analysis to solve a real-world sports question. Our work demonstrates that scientific testing can improve athletic performance and challenge common basketball assumptions.

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Abstract: Science and Engineering Fair of Houston

1378

How simulations can help people learn.

Warren Pickney

Charter/SST - Champions College Prep - MS

Category:

Software Design

I hypothesized that simulations would make students learning greater than regular teaching and prior knowledge. My research questions are "Do simulations help further our understanding of topics?" and "Can simulations be game changers in schools?". I expected the people that did the simulation to do better on a quiz than people who didn't. This project is important because I want people to learn how simulations can help them learn. When I started this project I was hoping to discover the simulation games can help people learn better than people who got regular learning. This research is important scientifically and is applicable because it will show if simulations can better our learning or not. In society teachers and administrators will look at projects like mine and say, "Simulations could help our students."

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Abstract: Science and Engineering Fair of Houston

1379

FallResQ : An AI-Powered App To Save Lives After A Fall

Vihaan Ganga

Friendswood ISD /Friendswood Junior High

Category:

Software Design

Background: Falls are leading cause of injury and emergency department (ED) utilization, particularly among older adults. Uncertainty regarding post fall care often results in unnecessary ED visits or delayed treatments of serious injuries. Artificial intelligence-based triage tool may support safer and more efficient decision making. Objective: To develop and evaluate an AI powered mobile application with AI (FallResQ AI) for post-fall triage and compare its performance with primary care physician (PCP) judgement. Methods: A dataset of 45 participants with real world fall events was collected, including demographic information, fall characteristics, pain severity, head injury status and walking ability. Machine learning model (logistic regression and feed-forward neural networks) were trained using PyTorch software with an 80/20 train-test split. Model performance was assessed using accuracy, precision, specificity, sensitivity, F1 Score, and area under the receiver operating characteristic curve (AUC-ROC). Classification thresholds were optimized using Youden's J statistic. AI predictions were compared with PCP judgement for clinical validation. Results: The deployed neural network achieved an AUC of 0.9625, accuracy of 0.911, precision of 0.950, sensitivity of 0.864, specificity of 0.957, and F1 score of 0.905. PCP judgement demonstrated higher sensitivity(0.957) and accuracy (0.956), reflecting strong clinical performance. Pain severity, head injury and inability to walk were significantly associated with PCP recommendations for ED evaluation($p < 0.001$). The AI model showed excellent discrimination and strong specificity, supporting its potential role in reducing unnecessary ED utilization while maintaining safety. Conclusions: FallResQ AI demonstrated high predictive performance and strong agreement with PCP judgement. As a decision- support tool, it may assist users in making informed post-fall care decisions and help optimize healthcare resources.

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1380

Using Machine Learning to Clear and Transcribe Unclear Speech Samples

Aditya Chanda, Josh Pal, Advik Singh

Fort Bend ISD /Quail Valley Middle School

Category:

Software Design

Speech recognition systems often struggle when audio is affected by background noise, distortion, or strong accents, reducing communication effectiveness and accessibility. This project presents a web-based systems software solution that enhances unclear speech and improves transcription accuracy using machine learning. The system combines audio preprocessing, a convolutional neural network autoencoder for speech enhancement, and an automatic speech recognition model into a single end-to-end pipeline accessible through a browser interface. Input audio, recorded through a microphone or uploaded as a file, is first normalized and converted into a consistent format. A CNN-based autoencoder is then used to reduce noise and distortion in the speech signal. The enhanced audio is passed to a speech recognition model to produce text output, with users able to choose between text or enhanced speech playback. The backend handles model inference and processing, while a lightweight frontend provides user interaction. Evaluation was performed using objective audio quality metrics. The enhancement model achieved a mean squared error of 0.0083 and improved signal-to-noise ratio by an average of 0.94 dB. Perceptual quality and intelligibility metrics showed strong performance, with a mean PESQ score of 2.83 and a STOI score of 0.85, indicating improved clarity and understandability compared to unprocessed audio. These results support the hypothesis that audio enhancement improves transcription readiness. Potential applications include online meetings, education, accessibility tools, and customer service systems. Future work includes integrating a neural vocoder such as HiFi-GAN for more natural speech synthesis, expanding training data, and enabling real-time processing.

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