International Journal of Modern Engineering and Management | IJMEM
ISSN No: 3048-8230
Volume 1, Issue 3, Aug- 2024

Workout Assistant and Fitness Guide using Machine Learning

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Abstract: **Virtual assistants have become an essential part of modern life, with approximately 27% of individuals relying on AI virtual assistants for various daily tasks. Building on this trend, our project explores the innovative application of AI in fitness through the development of "Fit Exercise," a cutting-edge AI-based workout assistant. The Fit Exercise app is designed to enhance workout routines by accurately detecting exercise poses, counting repetitions, and offering personalized feedback on form improvement. Utilizing MediaPipe for pose detection, the app analyzes pose geometry from real-time video data and user inputs to track and count exercise repetitions. Through this advanced technology, Fit Exercise aims to provide users with detailed guidance and optimize their workout performance.**

Keyword-AI, Virtual assistant, CNN, workout assistant, Pose estimation. Blaze pose, OpenCV.

I. INTRODUCTION

People are inherently susceptible to various health issues, with muscle disorders being a significant concern that requires timely treatment. Each year, millions experience muscle disorders due to accidents or the aging process. Yoga can be highly beneficial in improving physical health and mitigating these issues. However, incorrect exercise techniques can lead to serious health risks, underscoring the importance of proper instruction, especially for individuals practicing independently.Proper guidance in yoga is essential to maximize its benefits and enhance overall health. Yoga postures are designed to foster awareness, harmony, and strength in both the mind and body. Conversely, performing yoga postures incorrectly can result in severe complications, including strokes and nerve damage. Therefore, it is crucial to ensure that yoga practices are executed with correct posture and technique to avoid such risks and achieve optimal health benefits.

II. RELATED WORK

1) A. Yoga Frameworks

YogaST is a self-training framework designed to help users achieve accurate yoga poses and prevent injuries from incorrect stances. The system uses two Kinect 1 devices positioned in opposing directions to capture a comprehensive body map. It processes the images to create a contour map and applies line masks to compare and analyze the user's posture against the correct pose. A significant challenge in this framework is dealing with body part occlusions, which can complicate accurate segmentation.

Eyes-Free Yoga is an exergame designed for individuals with visual impairments or low vision. It employs a Kinect 1 device and provides users with audio instructions for six standing yoga poses. The system calculates body angles using the Law of Cosines, a method popular in early Kinect applications for gesture recognition. The framework includes 11 rules per pose to guide adjustments in body alignment, facilitating precise corrections.

Despite the various methodologies and solutions available, our interactive system aims to offer a faster and more robust method for pose recognition, enhancing the effectiveness of yoga practice through advanced technology.

III. CHALLENGES

A. Alignment

Maintaining proper alignment without a teacher's guidance can be challenging and may result in incorrect postures. Proper alignment is crucial for maximizing the benefits of each pose and preventing injuries. Without professional feedback, individuals may struggle to ensure their body is positioned correctly, leading to potential strain or injury.

B. Balance

Achieving and maintaining balance in yoga poses can be difficult without external support or guidance. Certain poses require a high degree of stability and strength, and practicing alone may make it harder to master these skills. A teacher's guidance or the use of props can be invaluable for developing and maintaining balance.

C. Safety

The risk of injury increases, especially in advanced poses, when practicing without assistance. A teacher can help ensure that poses are performed safely and can offer modifications or adjustments to avoid strain. Without this support, practitioners might attempt poses that are beyond their current skill level, leading to a higher risk of injury.

D. Motivation

Staying motivated and disciplined in yoga practice can be more challenging when practicing alone. Without the

encouragement and accountability provided by a teacher or class setting, individuals might find it harder to maintain a regular practice and push through difficult poses or routines.

E. Progress

Progress in yoga may be slower without feedback from an instructor. An instructor provides personalized guidance and adjustments that can help deepen one's practice and improve technique. Without this feedback, individuals may not recognize areas for improvement or might miss out on techniques that could enhance their practice.

F. Variety

Incorporating new poses and techniques can be difficult without assistance or exposure to different styles of yoga. A teacher often introduces a variety of poses and techniques, helping practitioners to expand their practice and explore new aspects of yoga. Practicing alone may limit exposure to diverse styles and variations of poses, potentially stagnating progress.

IV. TECHNOLOGIES REQUIRED

1) Machine Learning and Its Transformative Impact

Machine learning, a pivotal subfield of artificial intelligence (AI), has revolutionized the 21st century by enabling computers to learn and enhance their performance from data without explicit programming. This transformative technology underpins numerous applications that shape our daily lives and drives innovations across various sectors.

Core Principles of Machine Learning

Machine learning operates on the principle of using algorithms to analyze and model data, enabling systems to make predictions or decisions based on that data. The process typically involves training a model on a dataset, evaluating its performance, and then using it to make predictions or classify new data. Key types of machine learning include supervised learning, where models are trained on labeled data; unsupervised learning, where models identify patterns in unlabeled data; and reinforcement learning, where models learn through trial and error by receiving feedback from their actions.

Applications of Machine Learning

The applications of machine learning are diverse and continually expanding:

1. **Recommender Systems**: Machine learning algorithms power the recommender systems used by online platforms like Netflix and Amazon, suggesting products or media based on user preferences and behavior.
2. **Fraud Detection**: Financial institutions use machine learning to detect fraudulent transactions by analyzing patterns and anomalies in transaction data.
3. **Self-Driving Cars**: Autonomous vehicles rely on machine learning to navigate complex traffic scenarios, make real-time decisions, and enhance safety.
4. **Medical Diagnosis**: Machine learning aids in diagnosing diseases by analyzing medical images, predicting patient outcomes, and personalizing treatment plans.
5. **Scientific Research**: The technology accelerates advancements in fields such as drug discovery and materials science by analyzing complex datasets and identifying patterns that inform research.

Challenges and Ethical Considerations

Despite its benefits, machine learning presents several challenges and ethical considerations:

1. **Data Privacy**: Machine learning systems often require access to large amounts of personal data, raising concerns about data privacy and security.
2. **Bias and Fairness**: Algorithms may inadvertently perpetuate or exacerbate biases present in the training data, leading to unfair or discriminatory outcomes.
3. **Transparency**: Many machine learning models, especially deep learning models, operate as "black boxes," making it difficult to understand how decisions are made.
4. **Accountability**: Determining responsibility for decisions made by machine learning systems, especially in critical areas such as healthcare or autonomous driving, remains a complex issue.

2) Technical Components

1. **DB SQLite**
2. SQLite is a high-performance, self-contained SQL database engine that operates on a file-based system rather than a client-server model. It is well-suited for applications requiring a portable and efficient database solution. SQLite stores all data in a single file, simplifying data management and enhancing performance for both small-scale and large-scale applications.
3. **Python**
4. Python is a versatile and widely-used programming language known for its simplicity and extensive library support. Its clear syntax and robust ecosystem make it a dominant choice in various domains, including web development,

data science, and automation. Python's libraries, such as NumPy, pandas, and TensorFlow, facilitate advanced data analysis and machine learning tasks.

3. DB Browser for SQLite (DB4S)

DB Browser for SQLite (DB4S) provides a user-friendly interface for managing SQLite databases. This open-source tool enables users to create, edit, and interact with databases through a spreadsheet-like interface, simplifying database operations. Advanced users can also execute SQL queries directly, offering flexibility for complex database management tasks.

5. **Logistic Regression (LR) Algorithm**
6.

Logistic regression is a statistical model used for classification tasks, particularly binary outcomes. Unlike linear regression, which predicts continuous values, logistic regression estimates the probability of a categorical outcome. It is widely used in machine learning for tasks such as spam detection, medical diagnosis, and binary classification. Logistic regression models the relationship between a binary dependent variable and one or more independent variables, providing insights into the likelihood of specific outcomes.

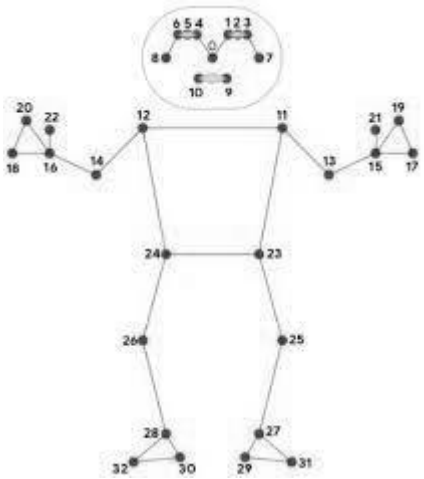
5. **LR Parsing**
6.

LR parsing is a deterministic method for syntax analysis used in compiler design. It processes input strings in a single pass and is capable of detecting errors early in the parsing process. The LR parser uses a table-driven approach to manage syntax rules and handle errors, making it efficient and effective for parsing complex languages and ensuring accurate compilation.

Overall, machine learning and its associated technologies are reshaping various industries and driving innovations. However, as the field continues to evolve, addressing challenges and ethical concerns remains crucial for ensuring responsible and equitable use of these powerful tools.

V. DATASET COLLECTION

Currently,it is quite challenging to come across a precise and efficient yoga-pose dataset online. The YOGI dataset includes a combination of standing and sitting poses, utilizing the entire body to showcase each yoga pose. These poses feature various hand and leg positions, posing a challenge for posture detection algorithms to function effectively. To address this issue, the YOGI dataset comprises 10 yoga poses that were captured using the burst feature of the camera. The images were captured with high precision and accuracy, resulting in a total of 5459 images in the compiled Color Image dataset, with each of the 8 yoga poses having approximately 400 to 900 images.



Collecting data manually of a huge volume requires a lot of effort, attention, and precision. Listed below is the procedure.

• A closed room was used to avoid any use of direct sunlight to get images without any reflection or glare.

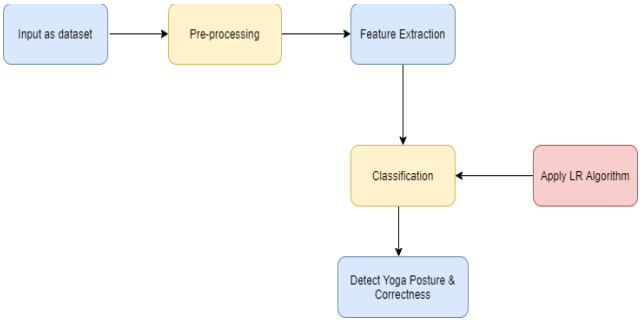
• The camera was mounted and adjusted on a tripod with an appropriate frame centering the person performing the yoga poses, and the distance was maintained around 4 to 5m between the camera and the person.

• The background was kept plain white to enhance and distinguish the yoga poses done by the person.

• Images of every pose were clicked from multiple directions and angle with the motion to capture every form of the pose, this helped to create a mixed Realtime dataset.

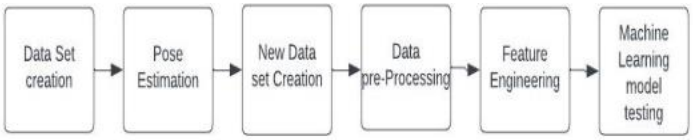
• Images of each pose were clicked in continuous mode ,25 images in a single go.

VI. ARCHITECTURE



VII. WORK FLOW

WORKFLOW PREPROCESSING: For preprocessing of data normalization is applied to the dataset. Machine learning models require normalized data to perform efficiently and provide good results.
DETECTION: Pre-processing and feature engineering is done on the testing data which was done on training data. The reason for this is that machine learning models understand the training data. Finally, the output is obtained for the test data and then fed to the trained model to evaluate its performance based on its predictions



VIII. RESULTS

1) Workflow Overview for Yoga Pose Detection and Analysis

1. Data Preprocessing:

Data preprocessing is a critical step in preparing data for machine learning models. For the yoga pose detection application, normalization is applied to ensure that the data is scaled appropriately. Normalization is crucial because machine learning models perform better when the input features are on a similar scale. This step involves adjusting the range of values in the dataset, making it easier for the model to learn and make accurate predictions.

2. Feature Engineering and Detection: Feature engineering is performed on both the training and testing datasets. This involves extracting relevant features from the data that will help the model understand and classify the yoga poses effectively. The pre-processing and feature engineering applied to the testing data should mirror the techniques used on the training data to maintain consistency.

The trained model is then used to make predictions on the test data. The output from the model is analyzed to evaluate its performance. This involves comparing the predicted poses against the actual poses to measure accuracy and other performance metrics.

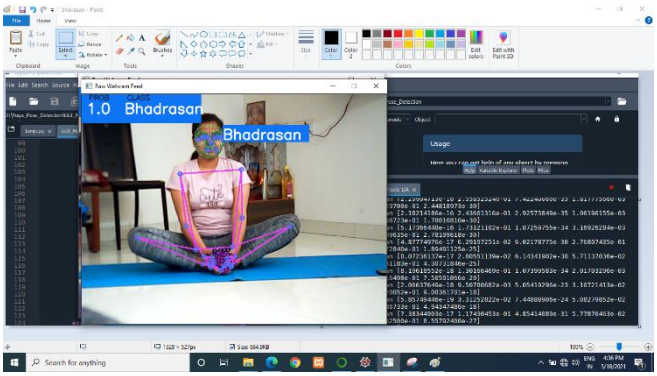
2) Yoga Poses

1. Bhadrasana (Butterfly Pose or Gracious Pose):

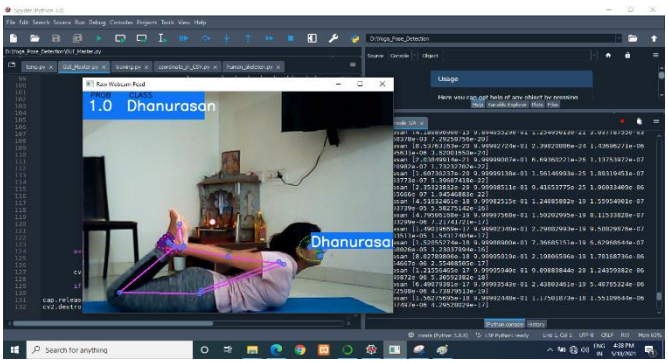
- **Description**: The Bhadrasana involves sitting with the soles of the feet together and the knees bent out to the sides. The spine is kept straight, and practitioners gently press the knees toward the ground to stretch the inner thighs and groins.
- **Benefits**: This pose improves flexibility in the hips and groin area, stimulates abdominal organs, and can relieve menstrual discomfort. It is often used as a preparatory pose for deeper hip-opening asanas.
- **Suitability**: Suitable for practitioners of all levels.

2. Dhanurasana (Bow Pose):

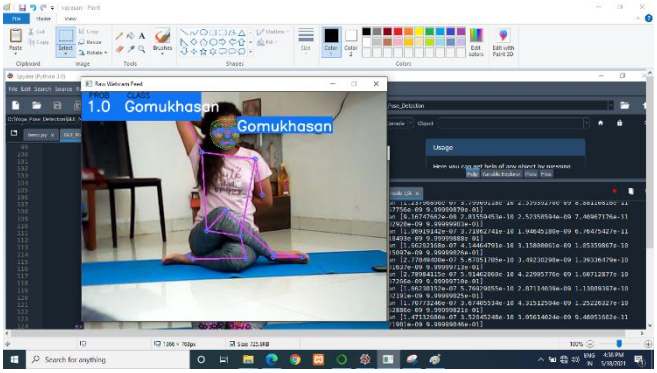
- **Description**: In Dhanurasana, practitioners lie on their stomachs and reach back to grasp their ankles with their hands. They then lift their chest and legs off the ground, resembling a bow shape.
- **Benefits**: This pose stretches the front of the body, including the chest, abdomen, and thighs, while strengthening the back muscles. It stimulates digestive organs and can alleviate mild backaches.
- **Level**: Intermediate; often included in yoga sequences for its energizing effects.



Bhadrasana



Dhanurasana



Gomukhasana

Gomukhasana (Cow Face Pose):

- **Description**: Gomukhasana, or Cow Face Pose, is a seated yoga posture where one knee is stacked over the other, and the feet are positioned beside the hips. The arms are extended behind the back, with one elbow pointing upward and the other downward. If possible, the hands are clasped together behind the back.

- **Benefits**: This pose provides a deep stretch to the shoulders, chest, arms, hips, and thighs. It improves posture, alleviates tension in the shoulders and upper back, and enhances flexibility in the hips and groin. Gomukhasana is accessible to practitioners of all levels, with modifications available for those with limited flexibility.

The above shown figures show the work of analyzing the yoga posture by indicating the probability at 1. At the left corner of the image show the accuracy of your posture that if it position is less than 1 then it needs improvement but if it is 1 or more than the accuracy of the pose is correct.

Probability	Result
< 1	False
>=1	True

IX. CONCLUSION

In today's fast-paced world, finding time for regular exercise and maintaining good health has become increasingly challenging. This busy lifestyle has led to a rise in various health issues and diseases. However, the integration of Artificial Intelligence (AI) into the fitness industry offers promising solutions to these problems.AI-driven health and fitness applications are revolutionizing how we approach exercise and wellness. By leveraging advanced technologies, these applications provide personalized guidance, enhance workout efficiency, and reduce the likelihood of errors. As a result, individuals can achieve their fitness goals more effectively and with greater accuracy.

Through this project, we explored the potential of AI in fitness, specifically by implementing machine learning and utilizing the OpenCV library. These tools have demonstrated their capacity to improve workout routines, offering a more informed and efficient approach to personal health and fitness.As we continue to integrate AI into various aspects of our lives, it is clear that such innovations not only make our fitness journeys more manageable but also contribute significantly to overall well-being.

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