Meta Fit

#### Project report in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology

**In CSE(AI & ML)**

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# CERTIFICATE

This is to certify that the project titled **“Meta Fit”** submitted by **MD ADIL NOWAZ (University Roll No.**12021002028089**), DEEPASREE DAS (University Roll No.** 12021002028040**)**,

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*Prof. Sristi Dey*

*(Dept. of CSE(AI & ML)*

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I would like to acknowledge that this project was completed entirely by me and not by someone else.

Last but not the least, we would like to extend our warm regards to our families and peers who have kept supporting us and always had faith in our work.

*Md Adil Nowaz*

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**ABSTRACT**

Meta-Fit Is designed and developed to recognize yoga stances and respond with a customized response to help users improve their postures. Our system will detect various yoga poses, namely Tree Pose, Warrior Pose, Downward Dog Pose, Mountain Pose, Warrior Pose, Goddess Pose etc.

Working of Meta-Fit: User can either upload a picture of a Yoga pose or pose directly in front of a camera and the system will automatically detect and show the name of the yoga pose.

***Advantages of Meta-Fit:***

1. The system is easy to maintain.
2. It is user-friendly.
3. The system successfully helps to identify Yoga poses.
4. It aims to help users improve their poses.

# INTRODUCTION

**Meta-Fit** classifies various Yoga poses and not just static pictures but also real-time yoga poses performed in front of the camera. Yoga is a form of exercise that is beneficial for health, focusing on physical, mental, and spiritual connections. However, practicing yoga and adopting incorrect postures can cause health problems, such as muscle sprains and pain.

Traditionally, gym trainers and yoga instructors have relied on their expertise and experience to develop training plans based on generalized principles. However, these one-size-fits-all approaches may not cater to the unique needs, preferences, and limitations of each individual. These systems have the potential to revolutionize traditional fitness practices by offering personalized guidance, optimizing workout routines, and enhancing overall user experience. The poses in datasets used for this project are done by experts. Models should accurately classify poses, even though they are nearly the same poses with a slight difference in them.

With the need to be fit and healthy on the rise today, **Meta-Fit** proves to be a valuable solution. It tracks how long you hold a yoga pose and keeps a track record which motivates you in your journey. These instructions help users improve their poses so that it is productive and not detrimental. It educates users of various poses and it is benefits along with proper guidance on how to perform them.

# SURVEY

##### Project Background

The systems is a need in current age of development as today’s generation is so conscious about their health and yoga is an easy and interesting way to be healthy.

The utilization of posture assessment for yoga is trying as it includes complex setup of stances. Researches have been done on yoga pose detection and correction. Some researchers have used Logistic regression to form a human posture. To avoid this problem we have used machine learning algorithms have been used. Using this one can find the coordinates of the joints and use that as a feature to detect the posture of a body. Machine Learning is a sub-area of artificial intelligence, whereby the term refers to the ability of IT systems to independently find solutions to problems by recognizing patterns in databases. In other words: Machine Learning enables IT systems to recognize patterns on the basis of existing algorithms and data sets and to develop adequate solution concepts.

##### Previous Work:

* ***PROJECT 1:***

“**A Proposal of Yoga Pose Assessment Method Using Pose Detection for Self- Learning**” By M. C.

Thar, K. Z. N. Winn University of Information Technology Okayama University. This paper put forward a Yoga pose assessment method using pose detection to help the self-learning of Yoga. This paper proposed a Performance Evaluation System as Yoga Pose Training System to help the self-learning of Yoga. This paper proposed how to explore yoga poses using pose discovery to help self study of yoga.[1]

* ***PROJECT 2 :***

“**Real-time Yoga recognition using deep learning**” By S. K. Yadav, A. Singh, A. Gupta and J. L. Raheja, Springer-Verlag London Ltd., 2019.

An in-depth hybrid learning model is proposed using CNN and LSTM to monitor yoga in real-time videos where the CNN layer is used to extract features from the key of each frame found in open pose and followed by LSTM to provide temporary predictions. This paper shows a mobile assistant yoga app based on human key acquisition models for video chat.[1]

* ***PROJECT 3 :***

“**Miss Yoga: A Yoga Assistant Mobile Application Based on KeyPoint Detection**” By Sylvie Gurbax.

This paper shows a yoga assistant's mobile app based on personal key model simulation models where real yoga instructors guide and supervise their students to practice yoga with video chat. An in-depth hybrid learning model was proposed using CNN and LSTM to recognize yoga in real-time videos.[1]

* ***PROJECT 4 :***

“**Real-Time Anomaly Detection and Localization in Crowded Scenes**” By Ammar Ladjailia.

A fully unsupervised dynamic sparse coding approach for detecting unusual events in videos based on online sparse constructability of query signals from anatomically learned event dictionary. Authors propose a fully unsupervised dynamic sparse coding approach for detecting unusual events in videos based on online sparse constructability of query signals from an atomically learned event dictionary, which forms a sparse coding base.[1]

* ***PROJECT 5 :***

“**Learning Temporal Regularity in Video Sequences**” By Jozsef Suto.

The authors approach this issue by studying the production model of so-called normal motion patterns using multiple sources with limited control. Two-mode auto-built-in autoencoders with unencrypted performance especially we suggest two built-in autoencoders so that they can operate without minimal guidance.[1]

* ***PROJECT 6 :***

**Zyoga was initiated home workouts during the pandemic up-to 5,000 users.**

The app is looking to onboard other fitness programmes. According to app analytics platform App Annie, many new fitness and health apps were launched in 2020 to support mental and physical health. A 13 percent increase over 2019. Zenia, the firm calls it “the world’s first AI-powered yoga assistant". Wearable X company advanced a wearable product called NADI, which guides us exercise via a mobile app. But yoga pose detection through a mobile phone is difficult task.[1]

* ***PROJECT 7 :***

**The author, S. Haque has presented a way to detect human body pose by using 2D technique exercise with the help of Convolutional Neural Network**.

It has multiple approaches such as body to augmented reality, fitness, animation by using Images and videos along with computer techniques.[1]

* ***PROJECT 8 :***

**Deshpande designed a self-instruction system by using a PC camera which detects multiple body parts through pose detection. LSTM identification captures real-time videos and detection is made by the use of CNN layer**.

In addition, an advanced algorithm is applied to detect various yoga poses under different circumstances and is robust also.[2]

* ***PROJECT 9 :***

**The author, M. Islam used a system for Musculoskeletal disorder which occurs due to accidents or aging.**

In this, a system is used to monitor various body movements of different yoga poses in real time by capturing different angles of a human body.[2]

* ***PROJECT 10 :***

M. Shivarama Reddy, In this research the approach of e-Yoga is for regular intervals and categorized at two different types:

1. **Simple yoga which uses video analysis and**

(ii) **Advanced yoga includes motion analysis which is provided to the user to stay fit and healthy especially IT professionals**. The techniques include a single camera or webcam for body detection. Once human structure is identified, 3D structure tries to foam from 2D images. The method is called SIFT and SURF algorithms.[2]

# PROBLEM STATEMENT

In the realm of yoga practice, there exists a challenge that hinders the full potential of practitioners: the prevalence of inaccurate poses leading to errors and accidents which intern causes negative effect on the body. Despite the increasing popularity of yoga as a holistic approach to physical and mental well-being, many individuals face difficulties in achieving precise and correct postures due to a lack of real-time guidance and feedback. This gap not only impedes the effectiveness of yoga sessions but also poses a risk of injury to practitioners who may unknowingly engage in improper poses, diminishing the overall safety and benefits of the practice.

Existing solutions, such as in-person instructors or video tutorials, often fall short in providing instantaneous corrections tailored to individual practitioners. This limitation results in a significant barrier for those seeking to enhance their yoga experience.

To address this challenge, there is a pressing need for an innovative application that leverages advanced technologies, such as computer vision and machine learning, to analyze and correct users' yoga poses in real-time. By minimizing errors and accidents through personalized feedback, this application aims to revolutionize the way individuals engage with and benefit from yoga, fostering a safer and more effective practice for practitioners of all levels.

* **Key Points:**
* Many struggle to get yoga poses right, leading to mistakes and accidents.
* Current solutions lack immediate and personalized feedback.
* We need a new app that uses technology to provide real-time feedback during yoga.
* This app could use computer vision and machine learning to analyze and correct poses.

Instant feedback would make yoga safer and more effective for practitioners of all levels.

# PROPOSED SOLUTION

##### SOLUTION:

In a world that increasingly prioritizes holistic well-being, the fusion of technology and fitness has become a beacon guiding individuals on their journey to healthier and more balanced lives. As we embrace the era of digital transformation, our mission is to revolutionize the way people approach exercise and yoga. With a vision grounded in accessibility, motivation, and personalization, we present an innovative solution - an Exercise and Yoga Tracker designed to empower users on their unique paths to fitness.

This comprehensive platform is more than just a tool; it's a companion for individuals seeking a harmonious blend of physical activity, mindfulness, and community support. Our commitment lies not only in the integration of cutting-edge features but also in the creation of an immersive and personalized experience that transcends the traditional boundaries of fitness apps.

As we delve into the details of our proposed solution, envision a world where technology seamlessly enhances our well-being, fostering a sense of connection, accomplishment, and joy in every step, stretch, and moment of self-discovery. Welcome to a new era of wellness, where our Exercise and Yoga Tracker becomes the catalyst for transformative journeys towards a healthier, happier, and more balanced life.

##### ADVANTAGES: -

*a*.

**User-Friendly Interface:**

An intuitive and user-friendly interface to ensure easy navigation for users of all fitness levels. Visually appealing graphics and icons to make the app engaging and motivating.

*b.*

**Personalized Profiles:**

Implements user profiles that allow individuals to set personal goals, track progress, and customize their workout preferences.

Provides options for users to input their fitness levels, health conditions, and preferences to tailor the experience to their specific needs.

*c*.

**Comprehensive Exercise Database:**

A vast database of exercises and yoga poses with detailed instructions and videos.

*d.*

**Progress Tracking and Analytics:**

Incorporates a robust tracking system to monitor users' progress over time.

Includes charts and analytics to visualize achievements, providing motivation and a sense of

accomplishment.

*e.*

**Offline Access:**

Allows user to download workouts for offline access, catering to those without constant internet connectivity.

*f.*

**Feedback Mechanism:**

Includes a feedback mechanism to gather user input and continuously improve the app based on their needs and preferences.

*g*.

**User Education Section:**

Includes a section with educational content on the benefits of different exercises, proper form, and the science behind fitness and yoga.

*h***.**

**Device Compatibility:**

Ensures compatibility with a wide range of devices like Web, Android and IOS to offer users flexibility in their choice.

# EXPERIMENTAL SETUP

##### WORKING MECHANISM:

The website employs image processing using computer vision algorithms to analyze uploaded images or live camera feeds of yoga poses. It detects key body points, discerns posture and alignment, and matches these details with a database of known yoga poses. Here is a more detailed explanation of each step:

1. **Select Image:-**The user selects an image from the database. This can be done manually or automatically, using a variety of methods such as image retrieval algorithms.

2. **Preprocess Image:-** Once an image has been selected, it is preprocessed to improve its quality and remove any artifacts. This may involve steps such as:

* Resizing: The image may be resized to a consistent size, making it easier to process.
* Noise reduction: Any noise in the image, such as grain or speckles, may be removed.
* Contrast enhancement: The contrast of the image may be enhanced to make it easier to see the features of interest.
* Color correction: The colors in the image may be corrected to be more accurate.

1. **Classify Pose:-** The preprocessed image is then classified to determine its pose. This is done by comparing the image to a database of known poses. The pose of the image is determined based on the closest match in the database.
2. **Update Database:-** The classified pose is then used to update the database. This may involve adding the new pose to the database, or updating the existing pose data.This process can be used for a variety of image processing tasks, such as:

* Image retrieval: Finding images in a database that match a given query image.
* Image classification: Identifying the objects or scenes in an image.
* Object tracking: Following the movement of an object in a video sequence.
* Pose estimation: Determining the pose of a person or object in an image.
* Image segmentation: Separating the different objects in an image from each other.

**Key process:-**

1) Data set Creation

2) Pose detection

3) Image Classification.

##### DATASET CREATION:

Creating a dataset for pose detection and image classification involves collecting diverse images or videos showcasing various yoga poses. Annotating these visuals with precise key point markers is crucial for accurate model training. Rigorous quality checks ensure annotation consistency and accuracy. Employing data augmentation techniques amplifies dataset diversity and mitigates overfitting. Here's a step-by-step guide on how the code contributes to dataset creation:

1. **File Transformation:**

* **Image Format Conversion:** The script loops through folders in the specified directory. For each folder, it converts PNG images to JPG format using the Pillow library's Image module. This step ensures uniformity in image formats within the dataset, facilitating standardized processing for future steps.
* **Conversion and Deletion:** Once converted, it saves the JPG images while removing the original PNG files to save storage space and maintain a streamlined dataset structure.

1. **File Renaming:**

* **Sequential Renaming:** The script then renames the files within each directory in a sequential manner, starting from '1.png' onwards. This step ensures consistent naming conventions, crucial for organizing and labeling images in the dataset.

1. **Implementation and Application:**

* **Application to Test and Train Datasets:** The code is designed to perform these transformations on both 'test' and 'train' datasets, improving consistency and readiness for training machine learning models.

1. **Usage of PIL Library:**

* **Pillow (PIL Fork):** Utilizes the 'PIL' library, especially the 'Image' module, for image processing tasks like format conversion and manipulation.

1. **Main Function Execution:**

* **Execution Condition:** The script runs these dataset transformation functions within a 'if name == 'main':' block, ensuring execution when the script is directly run.

##### POSE DETECTION:

It is a computer vision technique that identifies and locates key points, such as joints or body parts, within images or videos. It aims to understand and analyze the spatial arrangement of a person's body, enabling applications in activity recognition, gesture analysis, and human-computer interaction, among others. So, if we look into the step-by-step annotation of the pose detection process: -

1**. Data Collection and Preprocessing:**

* Gather a diverse dataset containing images with annotated keypoints representing various yoga poses. Preprocess the dataset, ensuring uniformity in image formats and labeling.

2. **Model Training:**

* Employ a pose estimation model such as OpenPose or PoseNet. Train the model using the annotated dataset to learn the spatial relationships between body keypoints in yoga poses.

3. **Model Evaluation:**

* Assess the trained model's accuracy and performance on a validation dataset. Evaluate metrics like keypoint accuracy, mean average precision (mAP), or intersection over union (IoU) to gauge model effectiveness.

4. **Inference and Pose Detection:**

* Apply the trained model on new or test images to perform pose detection. The model predicts keypoint locations, identifying body joints and postures, enabling the identification of yoga poses within images.

5. **Visualization and Analysis:**

* Utilize visualization tools like Matplotlib to display detected keypoints on images. Analyze the model's performance, identify any misclassifications, and improve accuracy if necessary through model retraining or dataset augmentation.

6. **Deployment and Iterative Refinement:**

* Deploy the pose detection model within the website framework. Gather user feedback to iteratively refine the model, improve accuracy, and enhance the user experience of the pose detection website.

##### IMAGE CLASSIFICATION:

The code snippet demonstrates a basic way to exhibit image classification output through visualization using Matplotlib.pyplot, where the image and its associated predicted label are presented for analysis or demonstration purposes. So here’s a step by step interpretation of the process:-

1. **Data Collection and Preprocessing:**

* Collect a diverse dataset containing labeled images for training an image classification model. Ensure uniformity in image formats and labeling.

2. **Model Training and Evaluation:**

* Train a deep learning model (e.g., CNN) using the collected dataset to classify images into predefined categories.
* Validate the trained model on a separate test dataset to assess its accuracy and performance.

3. **Backend Integration and Prediction:**

* Implement a backend system to receive user-uploaded images for classification.
* Preprocess the uploaded images to match the model's input requirements (e.g., resizing, normalization).
* Utilize the trained model to predict the class or label of the uploaded images.

4. **Display and Interaction using Matplotlib:**

* Integrate Matplotlib.pyplot within the frontend to display the uploaded images along with their predicted labels.
* Visualize the classification results by plotting the images with their predicted labels using Matplotlib's imshow() and annotation functions.

5. **User Feedback and Iterative Improvement:**

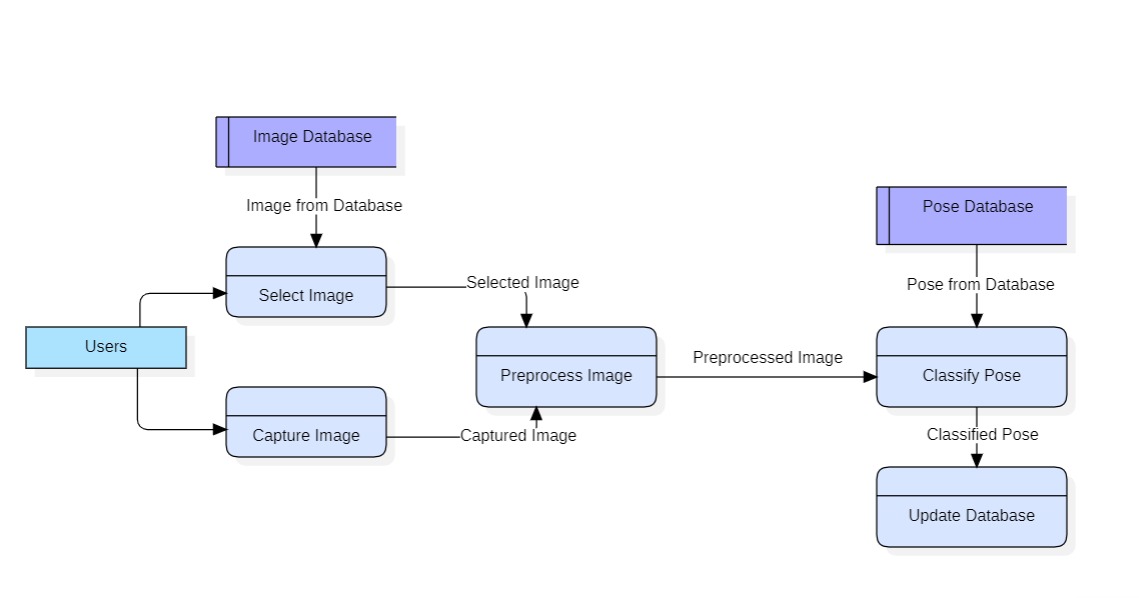
* Gather user feedback on the displayed classification results to improve model accuracy and system performance iteratively.

Use user interactions within the Matplotlib interface to allow exploration of detailed classification outcomes or downloading of results.

***RESULT ANALYSIS:***

The analysis of a yoga pose detection website encompasses evaluating accuracy metrics, visualizing detected poses for verification, gathering user feedback on usability, and studying error instances to identify improvement areas. Assessing model robustness across diverse body types, detecting biases in the dataset, and optimizing computational performance aids in refining the system. Continuous iterations based on user feedback and error analysis drive improvements, ensuring a more accurate and user-friendly experience for pose identification on the website.

**DFD DIAGRAM:**



# 

# ER DIAGRAM:

# 

# SEQUENCE DIAGRAM:

# 

# OUTPUT

# *SYSTEM INTERFACE:*

# 

# *SYSTEM OUTPUT:*

# 

**CONCLUSION**

In this project deep learning-based techniques are used to developed the detection of incorrect yoga posture. With this method, the user’s posture get detected and With these outputs, the system advises the user to improve the pose by specifying where the yoga pose is going wrong.  The proposed dataset can be expanded by adding required yoga pose key points. The research has extracted monitoring activities angles and used them as a feature as they are scaled. In some cases, if key points are rotated then angles are not changing, which does not deliver good results. In this system, angles with the ground are considered but not between joints, so if there is any slight rotation of key points, then angles are changed. With these features, multilayer perceptron is trained to achieve an accuracy of 0.9958 for testing datasets. The proposed approach maintains low computational complexity, can be applied to someone’s busy life for self-yoga learning, and can detect incorrect yoga posture to avoid chronic problems.

**FUTURE SCOPE**

* The technology may also be used to make real-time predictions and self-training on a mobile device.
* Although data analysis and machine learning algorithms, AI can customize your yoga practice based on your unique needs,
* It focuses on flexibility, strength, or stress reduction.
* It adapts and evolves with your progress, providing real-time feedback and guidance, much like a dedicated yoga instructor.
* There are several instances of real-life applications in which a single individual posture evaluation will not be enough
* This method to extract angles as features can be used for other applications like activity detection and sports activity monitoring.

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