KYPHOSIS, POSTURE-PAL AND ARTIFICIAL INTELLIGENCE

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19TH MARCH, 2024

Abstract

PosturePal: *Kyphosis Prevention and Curation App*, could be an innovative mobile application designed to revolutionize posture correction and spinal health management through the integration of ambient and wearable sensor technologies. By leveraging proprietary algorithms for intelligent activity classification, PosturePal can accurately classify postures such as standing, sitting, lying down, and stepping. The app utilizes a data fusion scheme to merge information from ambient and wearable sensors, enhancing the reliability of the platform for energy expenditure quantification.

Key features of PosturePal include personalized exercise programs, wearable device integration, and a supportive community forum. The app's machine learning algorithms, particularly Convolutional Neural Networks (CNNs), play a crucial role in analyzing user data, recognizing patterns in posture correction progress, and providing tailored exercise recommendations. Through continuous refinement and user feedback integration, PosturePal aims to empower users to improve their posture effectively and engage in proactive spinal health management. PosturePal represents a comprehensive solution that combines advanced sensor technologies, machine learning algorithms, and user-centric design to promote healthy postural habits and enhance overall well-being.

1. Problem Statement

Kyphosis, a spinal condition characterized by an excessive outward curvature of the upper back, poses significant health risks and discomfort to individuals. The lack of awareness, proper education, and accessible tools for prevention and management of kyphosis contribute to its prevalence and impact on daily life.

- Kyphosis is on the rise due to factors like sedentary lifestyles and lack of awareness.
- Unaddressed kyphosis can lead to pain, breathing difficulties, poor posture, and increased risk of falls.
- Early detection and accessible management strategies are crucial.
- Kyphosis can significantly impact physical and mental well-being.

The Call to Action:

- Raising awareness about kyphosis, its signs, and potential consequences.

- Developing accessible and affordable prevention and management programs.
- Providing ongoing support and motivation for maintaining good posture and exercise routines.

Kyphosis not only affects physical health but can also impact quality of life, causing pain, limiting mobility, and affecting self-esteem. The growing prevalence of this condition necessitates a proactive approach to prevention, early detection, and accessible management strategies. By addressing these challenges, we can empower individuals to take charge of their spinal health and prevent the negative impacts of kyphosis.

2. Customer/Market/Business Need Assessment for PosturePal

Market Need:

Kyphosis is increasing due to sedentary lifestyles and an aging population. The posture correction market is projected to grow significantly, reaching US$ 2.40 Billion by 2032. As of today, there is limited public awareness and knowledge about kyphosis and effective and affordable kyphosis prevention and treatment programs are not easily accessible. With ever changing needs there is a growing demand for self-management tools and mobile health solutions for proactive healthcare.

Customer Need:

Today users are seeking to prevent kyphosis and improve posture. People are looking for accessible, affordable, and convenient ways to manage kyphosis. Users are also interested in self-directed exercise programs and posture improvement techniques.

Business Need:

With this there is opportunity to address the healthcare concern with a scalable mobile app and potential to fulfilling the unmet needs of a large and deserved market segment. Also, potential partnerships with healthcare providers, fitness professionals, and wearable device companies will benefit massively. With also the aging population is more susceptible to kyphosis, creating a significant market as global population of 60+ age is expected to reach 2 billion mark. We

can establish a sustainable business model through in-app purchases, subscriptions, or premium features and freemium features.

3. Target Specifications and Characterization

Target Users:

- Location: Initially English-speaking audience, with plans for global expansion.
- Health-conscious individuals looking to prevent kyphosis and improve posture.
- People experiencing kyphosis-related pain, discomfort, or breathing difficulties.
- Users seeking self-directed, affordable, and convenient kyphosis management.

Technical Specifications:

- Compatible with smartphones and tablets (Android and iOS).
- Features cater to users with varying abilities and visual impairments.
- Prioritizes secure data storage and user privacy protection.
- Integration with wearable devices for posture monitoring.

User Needs:

- Tools and guidance to correct and maintain good posture.
- A user-friendly interface for smooth interaction.
- Ability to adjust settings based on individual needs and comfort levels.
- Real-time feedback on posture and corrective actions.
- Ensured accessibility for users with disabilities.

App Features:

- Easy-to-understand information about kyphosis, causes, symptoms, prevention strategies, and exercises.
- Simple tests and quizzes to assess kyphosis risk and track posture progress.
- Customized exercise routines based on user needs and fitness levels.
- Features like real-time feedback and reminders to maintain good posture.
- Charts and graphs to visualize progress and keep users motivated.

- A safe space for users to connect, share experiences, and offer support.

Additional Details:

- App size is optimized for storage and performance.
- Available in English, with planned translations for wider accessibility.
- In-app purchases offer additional features through subscriptions and premium options.

Overall Characterization:

PosturePal strives to be a user-friendly, informative, and engaging app that empowers users to take an active role in preventing and managing kyphosis. The app's design and tone are positive, supportive, and motivating to help users achieve their posture goals.

4. External Search

The sources provided include information on musculoskeletal conditions from WHO, the McKenzie Institute focusing on ideal posture, kyphosis in school-age children, a report on the posture correction market size and trends, and a forecast for the kyphosis correction belt market.

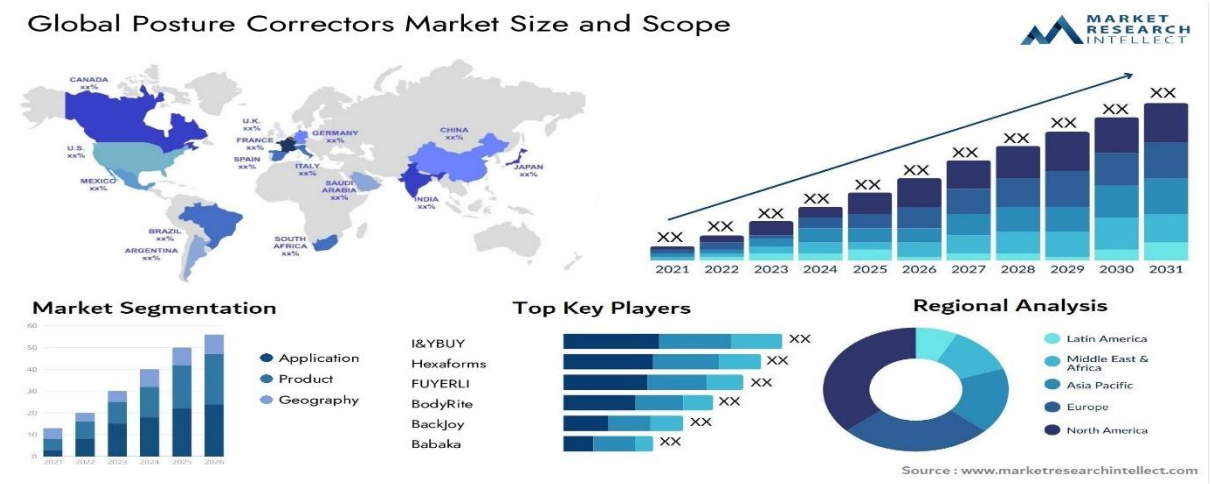
World Health Organization - Musculoskeletal Conditions: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

The McKenzie Institute - Ideal Posture: https://www.mckenzieinstituteusa.org/

https://www.linkedin.com/pulse/kyphosis-correction-belt-sales-market-size-forecast/

https://www.verifiedmarketreports.com/product/kyphosis-correction-belt-market/

https://www.databridgemarketresearch.com/reports/global-posture-corrector-market



5. Benchmarking alternate products

Online Yoga Classes and Mini-Gym Products:

a. **Features**: Virtual yoga sessions, mini-gym equipments for posture improvement.

b. **Comparison**: PosturePal app could integrates posture tracking, exercise guidance, and community support, combining the benefits of online resources with personalized feedback and monitering for a holistic posture correction solution.

6. Applicable Regulations

Following two could be the Regulations to be kept into mind while working into India. Meanwhile future expansion will have more regulations to pass but as of now just two into majority:

- **Indian Medical Council (MCI) Regulations:** The MCI regulates the practice of medicine in India. PosturePal should ensure it doesn't infringe on these regulations by staying clear of medical diagnoses or treatment recommendations.
- **Information Technology Act (2000) and Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules (2011):** These regulations focus on data privacy and security. PosturePal should collect minimal user data, prioritize strong data security measures, and obtain informed consent from users regarding data collection practices.

7. Applicable Constraints

- Limited budget for marketing and advertising campaigns to promote posture correction products, especially for small businesses or startups.
- Challenges in accessing specialized healthcare professionals or physiotherapists for expert guidance on posture correction methods and product development.
- Wearable Device Integration: Integrating with wearables might require additional development effort or licensing fees depending on the chosen platform
- Maintenance and Updates: Budget for ongoing maintenance, bug fixes, and new feature development to keep PosturePal functioning smoothly and competitive.

8. Business Model

PosturePal can explore various monetization options to create a sustainable business model. Here are some ideas to be considered while designing:

Freemium Model:

- Offer a free basic version of PosturePal with limited features like educational content, simple exercises, and basic progress tracking.
- Provide a premium subscription for access to advanced features like:
    - Personalized exercise programs based on user assessments.
    - In-depth educational modules on kyphosis and posture correction techniques.
    - Workout routines with video demonstrations.
    - Real-time posture monitoring through integrated wearables.
    - Access to a community forum for peer support and expert guidance.

In-App Purchases:

- Offer in-app purchases for users who want specific features without committing to a subscription, such as:

    - Individual premium exercise programs targeting specific goals (e.g., improving flexibility, strengthening core muscles).
    - Ad-free experience to enhance user experience in the free version.
    - Additional customization options for the app's interface.

Partnerships:

- Partner with healthcare professionals or physical therapists to offer premium consultations or personalized coaching plans within the app (revenue sharing model).
- Collaborate with fitness brands or wearable device companies for in-app promotions or bundled subscription offers.

Affiliate Marketing:

- Partner with relevant brands selling ergonomic products like chairs, back supports, or yoga mats. Promote these products within the app and earn a commission on each sale generated through PosturePal.

Data Insights:

- Consider offering anonymized and aggregated user data insights (while adhering to privacy regulations) to businesses in the health and wellness industry. This data could be valuable for product development, marketing strategies, or understanding user trends related to posture and kyphosis.

Choosing the Right Model:

- The best monetization strategy will depend on your target audience, app features, and competitive landscape.
- Consider starting with a freemium model to attract a large user base and then upsell premium features to a dedicated user segment.
- You can experiment with different monetization options and track user behaviour to see which strategies generate the most revenue.

Additional Considerations:

- Ensure a clear distinction between free and premium features to incentivize users to upgrade.
- Provide a seamless in-app purchase experience for a smooth user journey.
- Offer free trials for premium subscriptions to allow users to experience the value before committing.

By implementing a well-defined monetization strategy, PosturePal can generate revenue, achieve financial sustainability, and keep delivering its valuable posture improvement solutions to users.

9. Concept Generation

Here's a roadmap to develop design ideas for PosturePal:

1. User Research and Understanding:

- Conduct user interviews or surveys to understand target user needs, pain points, and expectations from a kyphosis prevention and management app.
- Analyse existing posture correction apps to identify best practices, user interface (UI) elements, and potential areas for improvement.

2. Design Sessions:

- Use techniques like mind mapping or role-playing to think outside the box.
- Aspects during brainstorming:
    - **User Interface (UI):** Explore clean, intuitive, and visually appealing layouts that are easy to navigate for users of all ages and technical skills.
    - **User Experience (UX):** Focus on creating a seamless and engaging experience. This includes a smooth onboarding process, clear instructions and track progress.
    - **Information Architecture:** Organize content logically and make it easy for users to find what they need.

- **Accessibility:** Ensure the app is usable by everyone, including users with visual impairments or other limitations.

3. User Flows and Wireframing:

- Develop user flows to map out the different user journeys within the app. For example, how a user would access an exercise program, track their progress.
- Create wireframes to visualize the app's layout, screen elements, and information hierarchy.

4. User Testing and Refinement:

- Conduct usability testing with a small group of target users to gather feedback on your initial wireframes.
- Observe how users interact with the app, identify any pain points or areas of confusion, and refine the design based on their feedback.
- Iterate on your wireframes and create high-fidelity mockups that represent the final visual design of the app.

Additional Considerations:

- **Brand Identity:** Develop a consistent brand identity for PosturePal that reflects its focus on health, wellness, and posture improvement. This includes logo design, color scheme, and overall visual style.
- **Data Visualization:** Present user data like progress charts, graphs, and posture assessments in a clear and visually appealing way to keep users motivated.

By following roadmap and incorporating user feedback through testing, we can develop a user-friendly, informative, and visually appealing design for PosturePal that effectively helps users prevent and manage kyphosis.

10. Concept Development

Concept Summary:

PosturePal is a mobile application designed to empower users to prevent and manage kyphosis, a condition characterized by an excessive rounding of the upper back.

Target Audience:

- Location: India (English speaking audience initially).
- Psychographics:
    - Health-conscious individuals interested in preventing kyphosis and improving posture.
    - People experiencing pain, discomfort, or breathing difficulties associated with kyphosis.
    - Individuals seeking self-directed, affordable, and convenient ways to manage kyphosis.
    - Users interested in maintaining good posture throughout the day.

Key Features:

- **Educational Content:** Easy-to-understand information about kyphosis, causes, symptoms, prevention strategies, and exercises.
- **Self-Assessment Tools:** Simple tests and quizzes to assess kyphosis risk and monitor posture progress.
- **Personalized Exercise Programs:** Customized exercise routines based on user needs and fitness levels.
- **Posture Monitoring:** Features like real-time feedback and reminders to maintain good posture through wearable device integration.
- **Progress Tracking:** Charts and graphs to visualize progress over time and motivate users.

Monetization Model:

- Freemium model with a free basic version and premium features accessible through subscriptions or in-app purchases.
- Partnerships with healthcare professionals or fitness brands for premium services or bundled offers.

- Affiliate marketing for ergonomic products relevant to posture improvement.
- Business-to-Business (B2B) model offering anonymized and aggregated user data insights (while adhering to privacy regulations).

Competitive Advantage:

- Focus on kyphosis-specific education and exercises, catering to a more targeted audience compared to general posture correction apps.
- Potential for real-time posture monitoring through wearable device integration for a more comprehensive approach.
- Building a strong community aspect within the app to foster user engagement and support.

Overall, PosturePal aims to be a user-friendly, informative, and engaging mobile app that empowers users to take an active role in preventing and managing kyphosis.

11. Final Product Prototype

PosturePal is a mobile health app designed to empower users to prevent and manage kyphosis. It offers a comprehensive approach through a combination of educational content, personalized exercise programs, posture monitoring and a supportive community forum.

Abstract:

The PosturePal app opens to a clean and intuitive home screen displaying key features:

- **Learn:** This section provides easily digestible information about kyphosis, causes, symptoms, prevention strategies, and the importance of good posture.
- **Assess:** Users can take self-assessment quizzes and posture tests to evaluate their kyphosis risk and track progress over time.

- **Move:** Based on the assessment results and user preferences, PosturePal generates personalized exercise programs with clear video demonstrations and instructions. The app allows users to adjust difficulty levels and track their workout progress.
- **Wearables:** Wearable devices will help us track Real-Time posture and sensors will help us with that and also using data we can remind or notify important thing via trigger or notification.
- **Community:** A dedicated forum allows users to connect with others, share experiences, offer encouragement, and ask questions from healthcare professionals or certified trainers (through occasional live Q&A sessions).
- **Profile:** Users can personalize their profiles, set goals, and track their progress through charts and graphs.

Schematic Diagram:

Home Screen

- Learn (Icon like Book)
- Assess (Icon like Checklist)
- Move (Icon as Person exercising)
- Community (Icon of Chat bubble)
- Profile (Icon of Person)

Learn Section:

- Subsections on kyphosis causes, symptoms, prevention tips, and posture exercises.
- Short videos and animations to enhance understanding.

Assess Section:

- Self-assessment quizzes on kyphosis risk factors and posture awareness.
- Simple posture tests with visual instructions.

Move Section:

- Personalized exercise programs based on user assessment and goals.
- Video demonstrations for each exercise with clear instructions.
- Ability to adjust difficulty level and track workout progress.
- Real-time posture feedback through integrated wearables.

Wearable Device Integration:

- Seamless integration with popular wearable devices like Fitbit and Apple Health.
- Automatic logging and tracking of workouts using wearable sensors.
- Real-time feedback and adjustments based on wearable data.
- Syncing workout data across multiple devices for ease of access.

Community Section:

- Safe space for users to connect and support each other.
- Discussion forums on kyphosis management, posture improvement tips, and general well-being.
- Live Q&A sessions with healthcare professionals or certified trainers (periodically).

Profile Section:

- User profile customization with setting options.
- Goal setting for posture improvement and exercise routines.
- Progress tracking through charts and graphs showcasing improvement over time.

Note: The PosturePal app will be designed to provide a comprehensive solution for users looking to improve their posture and spinal health. By combining personalized exercise programs, wearable device integration, and a supportive community forum, the app will offer a unique and engaging experience for users to achieve their posture goals.The final app design may include additional features and functionalities based on user feedback and future development.

12. Product details

Problem: People often lack awareness and accessible tools for prevention and management of Kyphosis.
Solution: PosturePal is a mobile application that empowers users to take an active role in improving their posture and preventing kyphosis.

How It Works

- **Onboarding:** Users set up a profile, take self-assessments, and define goals to create a personalized experience.
- **Personalized Programs:** Based on user data, PosturePal recommends customized exercise programs with video demonstrations and clear instructions.
- **Exercise & Tracking:** Users perform exercises, track progress through charts and graphs, and adjust difficulty levels as needed.
- **Learning & Community:** Users access educational content, participate in a supportive online forum, and attend optional live Q&A sessions with healthcare professionals.
- **Wearable Integration:** Connecting wearables like AirPods allows for real-time feedback during exercises and potentially tracks posture data throughout the day.

Data Sources:

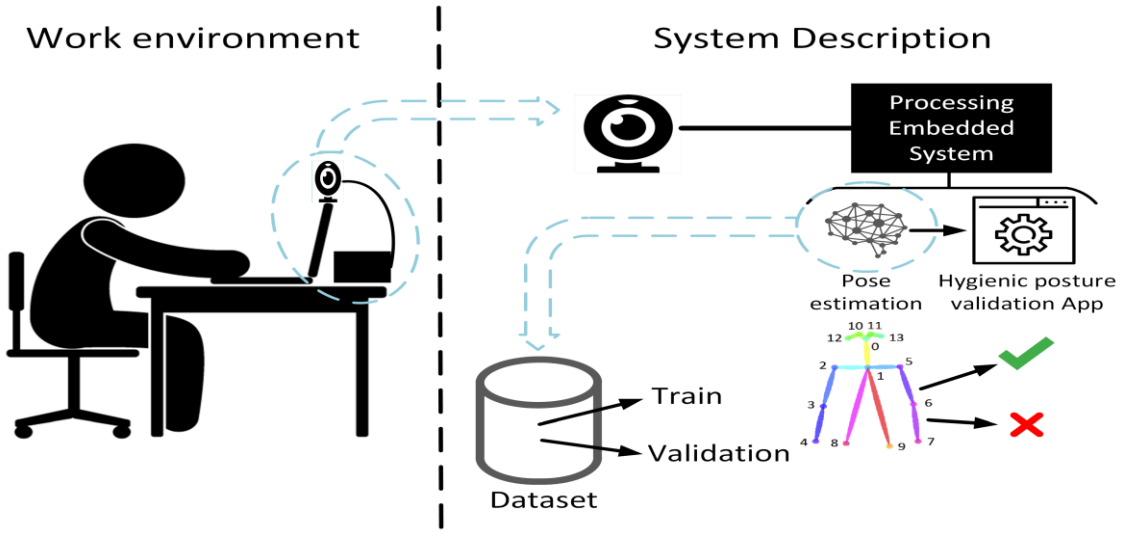
- PosturePal collects data from wearables (e.g., AirPods) to track head tilt and posture.
- User feedback and progress data are used to improve algorithms and personalize exercise routines.

Technology Stack:

- Android/iOS development tools
- Machine learning libraries
- Wearable device APIs
- Gamification framework

Algorithms & Frameworks:

- Recommendation Engine: Suggests relevant exercises based on individual needs.
- Progress Tracking Algorithms: Track user progress and visualize data.
- Machine Learning: Analyzes user data (including wearable data) for:
    - Advanced Posture Assessment with Wearables: Provides real-time feedback and visualizes posture data.
    - Personalized Exercise Recommendations: Creates tailored programs based on progress and posture data.
    - Identifying Underlying Issues (with Disclaimer): Analyzes data to potentially identify patterns requiring professional evaluation.

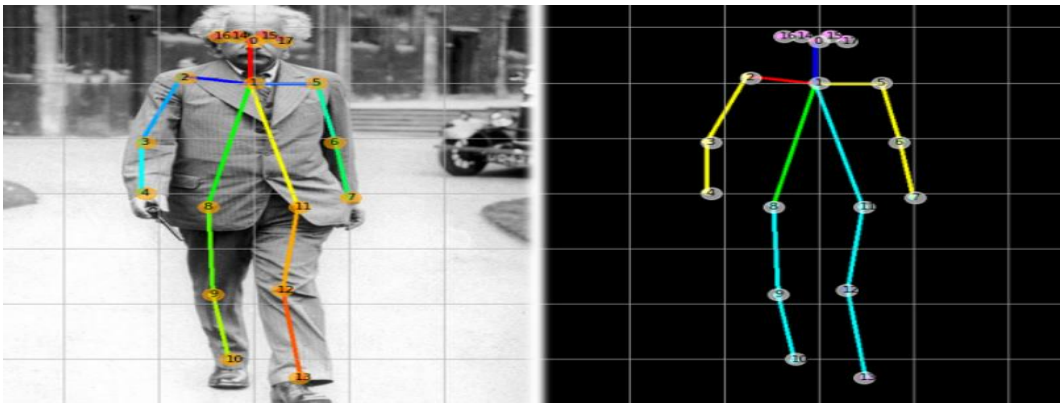


Benefits of Machine Learning Integration:

- Enhanced Accuracy: Improves posture detection with more user data.
- Personalized Experience: Provides tailored exercise programs and real-time feedback.
- Proactive Intervention: Helps users correct posture before discomfort or pain.
- Data-Driven Insights: Provides valuable data for app development and content creation.

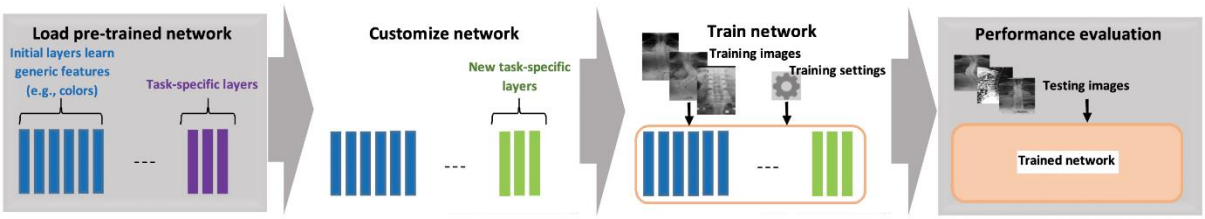
Challenges of Machine Learning Integration:

- Data Collection and Labelling: Requires a large amount of labelled data for training the ML model.
- Accuracy and Bias: Data quality and quantity impact accuracy, and biases can lead to skewed results.
- Computational Resources: Training complex models requires significant resources, impacting development costs or battery life.
- User Privacy Concerns: Requires transparency about data collection and robust security measures.



Convolutional Neural Network (CNN):

- Well-suited for pattern recognition in posture and activity data from wearables.
- Automatically learns features from raw sensor data, eliminating manual feature engineering.
- Captures spatial hierarchies for accurate understanding of body movements.
- Robust to variations in sensor data, handling noisy or occluded data.
- Deep learning capabilities enable handling large amounts of data and complex relationships.
- By leveraging a Convolutional Neural Network (CNN), the PosturePal app can effectively analyze data from wearable sensors, classify different postures and activities, and provide users with personalized feedback and exercise recommendations based on their movement patterns.



Team:

- Mobile app developers (Android/iOS)
- Machine learning engineers (optional)
- UX/UI designers
- Wearable device integration specialists (optional)
- Healthcare professionals
- Community managers

Cost & Monetization:

- Free download with a subscription-based premium version offering additional features (e.g., ₹99.9/month or ₹999.9/year).

Future Updates:

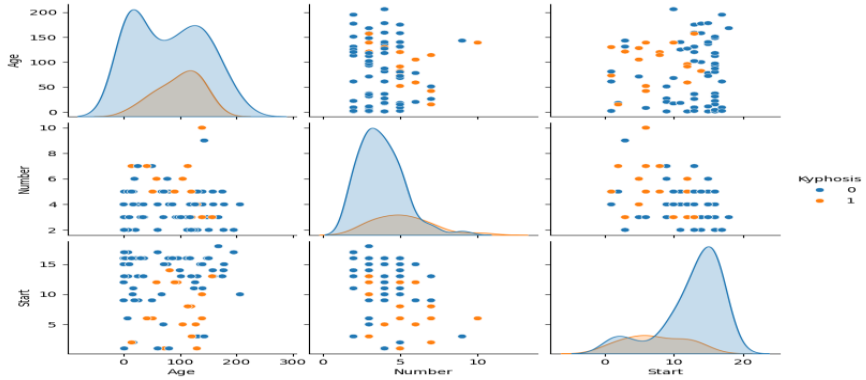
- Integration with additional wearables
- Expansion to other platforms (Windows, web)
- Integration with fitness tracking apps
- Personalized posture correction plans
- Advanced posture correction analytics
- VR/AR integration for an immersive experience

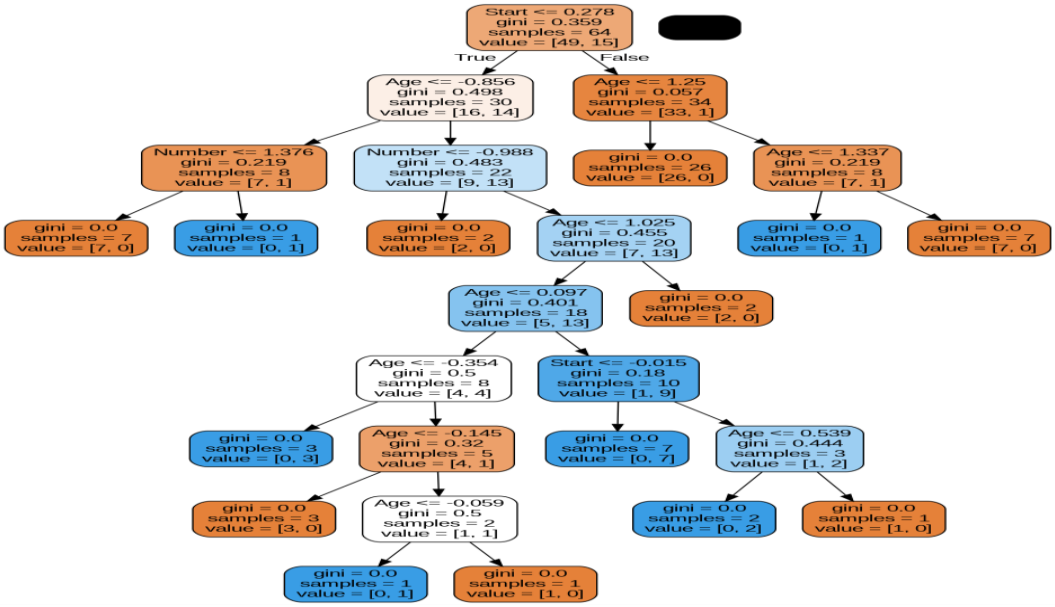
Additional Considerations:

- Data Security: Prioritize robust security measures to protect user privacy.
- Monetization Strategy: Define how PosturePal will generate revenue (freemium model, subscriptions, etc.).
- Compliance with Regulations: Ensure adherence to relevant data privacy regulations in target markets.

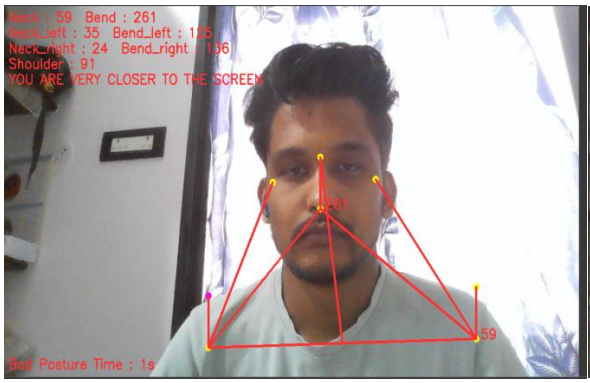
13. Code Implementation on Small Scale

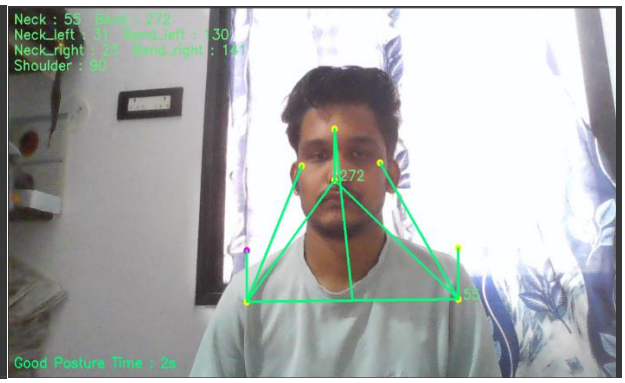
Kyphosis Disease Classification using Kaggle Dataset





Keypoints, mediapipe, openCV and Proximity concepts





14. Conclusion

The development of the PosturePal app represents a significant advancement in posture correction and spinal health management, offering users a comprehensive solution through innovative technology and user-centric design. By leveraging motion-tracking sensors, machine learning algorithms, and personalized exercise routines, PosturePal aims to empower individuals to enhance their posture effectively and proactively address spinal health concerns.

One of the key highlights of the PosturePal app concept is its focus on providing personalized exercise programs tailored to meet individual posture correction needs. This customization ensures that users receive targeted workout routines designed to address their specific posture issues, promoting better spinal alignment and overall well-being. Additionally, the integration of wearable devices allows for seamless connectivity with sensors, enabling real-time tracking and feedback on posture improvement progress.

The incorporation of advanced machine learning algorithms, such as Convolutional Neural Networks (CNNs), further enhances the app's capabilities by enabling precise analysis of user data, identification of patterns in posture correction progress, and provision of personalized exercise recommendations. This sophisticated technology ensures accurate posture assessment and tailored interventions for users committed to enhancing their spinal health.

Continuous refinement, user feedback integration, and collaboration with healthcare professionals are crucial for optimizing the app's effectiveness. Prioritizing user engagement, data privacy, and technological innovation positions PosturePal as a leader in posture correction and spinal health management.

In conclusion, PosturePal embodies a holistic approach to posture correction by combining cutting-edge technology with user empowerment. With its focus on innovation, user-centric design, and continuous improvement, PosturePal has the potential to make a significant impact on promoting healthy postural habits and empowering users to take control of their spinal health for improved well-being.