AN INTELLIGENT MOBILE APPLICATION TO ASSIST IN HEALING A DANCER'S INJURY USING ARTIFICIAL INTELLIGENCE

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ABSTRACT

This paper introduces "DanceWell," an app created to help dancers quickly get medical advice for injuries. The app was developed based on personal experiences and the difficulty of finding specialized care quickly and affordably. DanceWell uses artificial intelligence (AI) to analyze user input, such as symptoms and photos of injuries, to diagnose problems more accurately than traditional methods [1]. The app's main features include a photo upload tool for injury analysis and a set of yes/no questions tailored to each injury type. Experiments show that DanceWell can accurately provide medical advice, proving to be faster and more accessible than waiting for a doctor's appointment. The app makes it easier for dancers to get the right care quickly, allowing them to continue training and recover faster [2]. This project shows how AI can improve healthcare by providing specific, quick, and reliable support, suggesting that such technology should be used more widely.

KEYWORDS

Dance, AI, Doctor, App

1. INTRODUCTION

I created DanceWell, an innovative app designed to provide immediate, expert advice for dancers facing injuries. Drawing from over a decade of ballet experience, my motivation to develop DanceWell stemmed from my personal struggle to find specialized care after sustaining a ballet-related injury. In the dance world, accessing dance-specific medical experts is challenging due to their scarcity and often fully booked schedules. When I needed care, the earliest appointment available was a month away, and the sports doctor we managed to see did not accept our insurance, resulting in substantial out-of-pocket costs.

Recognizing that many dancers cannot afford or wait for specialized care, I designed DanceWell to act as a reliable virtual consultant—part doctor, part physical therapist—offering free, expert guidance on demand. Traditional medical professionals, even with extensive experience, might not fully understand the nuances of dance-related injuries. DanceWell addresses this gap by leveraging AI technology to provide dependable diagnoses.

The app prompts users to select the injured body part and answer 10 yes/no questions tailored to that area. Additionally, users can upload a photo of their injury. The app then utilizes AI to analyze swelling, discoloration, and other signs to help pinpoint the issue. It compares the symptoms against a database of common dance injuries, using all that data to provide a probable

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diagnosis [5]. DanceWell also offers treatment recommendations, including workout videos, to aid in strengthening the targeted muscles, recovery, and preventing future injuries.

The first methodology, traditional methods for dance injuries, based on physical exams and personalized treatments, focuses on visible symptoms and practitioner experience. Its effectiveness lies in direct patient interaction, but it can miss subtle underlying issues not evident without more sophisticated analyses and relies heavily on the subjective judgment of practitioners. In the second methodology, AI analysis of dance injury data, AI is used to analyze historical injury data to predict risks and suggest prevention strategies. While this method helps in avoiding injuries by learning from past cases, its accuracy may falter due to variations in individual dancer attributes and styles. It also depends heavily on the availability and quality of historical data. The third methodology, AI in general disease diagnosis, highlights AI's capability to quickly process large medical datasets, which can outperform traditional diagnostic methods [6]. However, it faces challenges in patient trust due to its lack of human touch and the opaque nature of its decision-making processes.

My solution to the lack of dance doctors and the expensive visit costs is a virtual dance doctor. This virtual dance doctor is available to give a diagnosis and treatment right when you need it, meaning you don't have to wait weeks for an appointment. Additionally, the app is free to use, so families who may not have the money to pay for a doctor's visit can still get a reliable diagnosis and treatment plan. By providing immediate access to medical advice, the app ensures that dancers can address their health issues without delay, keep their training schedules, and reduce the risk of long-term injuries.

This virtual dance doctor app addresses the problem by using AI technology to offer instant medical assessments and tailored treatment plans based on the user's input. It removes the need for immediate in-person consultations, which reduces waiting times and ensures dancers receive prompt care. This immediacy is vital for dancers who need quick recovery to continue their training and performances.

This solution is better than other methods because it directly addresses the lack of dance doctors and the high costs of visits. Unlike general medical apps or nonspecialized advice, the virtual dance doctor app provides specialized care tailored for dancers. It offers instant, free access to reliable diagnoses and treatment plans, ensuring dancers get the specific help they need without the wait and expense of traditional doctor visits. This makes it a more effective and accessible solution for dancers.

In section 4, I conducted two experiments focusing on the AI's accuracy. The first experiment tested the AI's ability to generate relevant questions based on a selected body part. I manually selected various body parts in the app and checked if the AI provided 10 relevant questions for each. This test aimed to ensure that the AI accurately links user input to specific medical questions without external control data. The results were all correct because my code should link the body part directly with the AI. The second experiment assessed the AI's diagnostic accuracy. I've run some trials and recorded the results the AI gives me. I haven't completed this part of the experiment yet, but I would compare the AI's answers to a medical professional's diagnosis and see how accurate it is. If the AI's diagnosis is different from a doctor's, it's important to keep in mind that the doctor's answer could be wrong rather than just assuming the AI's answer is wrong.

2. CHALLENGES

In order to build the project, a few challenges have been identified as follows.

2.1. Image Quality

A major component of my program is the image picker function that allows users to upload images of their injuries for AI diagnosis. Some potential problems are poor image quality and bad lighting, which could affect the accuracy of the diagnosis. To resolve these issues, I could use image processing techniques to enhance image quality and lighting. Additionally, I could implement guidelines for users on how to take clear and well-lit photos. Another potential problem is user privacy concerns, which I could address by encrypting uploaded images and ensuring they are securely stored and processed in compliance with privacy regulations.

2.2. User Answers

A major component of my program is the page that asks users 10 yes or no questions after they select the body part that hurts. Some potential problems are users misunderstanding the questions or providing inconsistent answers, which could affect the accuracy of the diagnosis. To address these issues, I could ensure that the questions use simple, clear language and provide examples to clarify each section. Additionally, I could implement validation checks to ensure that the answers are consistent. If there are any discrepancies, the system could prompt users to review their answers before submitting them, ensuring more reliable input for the AI diagnosis.

2.3. The Inaccuracy of the AI

A major component of the program is the AI diagnosis system. A potential problem is the inaccuracy of the AI, which could lead to incorrect diagnoses. To address this, I could train the AI with a large and diverse dataset of medical images and cases, ensuring it learns to recognize a wide variety of injuries and conditions. Additionally, I could regularly update the training data with new examples and feedback from users to continuously improve the AI's accuracy. Implementing a system where medical professionals review and validate AI diagnoses could also help enhance the system's reliability over time.

3. SOLUTION

My app begins with a login page, offering options for users to either log in with their existing credentials or to register a new account. This ensures both returning users and newcomers can access the app easily. Once logged in, the homepage presents two main options: "Get Started" and "About Us."

The "About Us" button directs users to a page detailing the app's mission, my personal story as the creator, and my contact information [7]. This page is designed to build trust by sharing the inspiration behind the app and how users can reach out with questions or feedback.

Clicking on "Get Started" leads to a pre-assessment page. This initial step educates the user on what the assessment will entail and sets expectations. Here, users select the specific body part they are concerned about, ensuring the subsequent questions are tailored to their particular needs.
After selecting a body part, users answer 10 tailored yes/no questions. These questions are designed to identify common symptoms and issues related to the chosen body part. Upon completing the questionnaire, users have two choices: they can either submit their answers to receive a diagnosis or they can enhance the diagnostic accuracy by uploading an image of the affected area.

The app then analyzes the provided information and, if an image is uploaded, it uses image recognition technology to offer a more precise diagnosis. The results page not only provides a clear diagnosis but also outlines effective treatment options and practical tips for preventing future injuries. This comprehensive approach ensures that users not only understand their current health status but are also equipped to improve and protect their well-being.

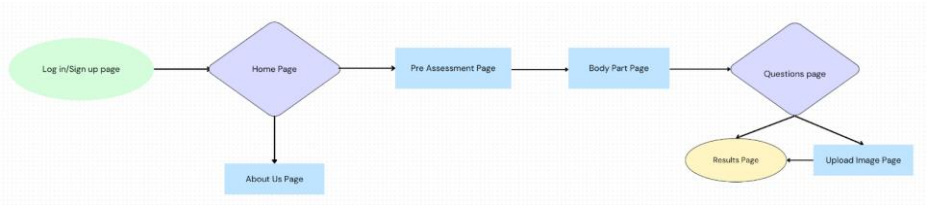


Figure 1. Overview of the solution

The questionnaire page is designed for the user to answer 10 yes or or no so the AI can have an accurate sense of what the injury is. It relies on Natural Language Processing (NLP) to interpret user inputs and Neural Networks to analyze and diagnose injuries based on the responses [8]. This ensures that the AI can provide precise and personalized medical advice, enhancing the overall effectiveness of the app.

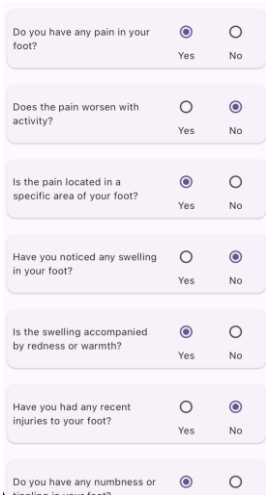


Figure 2. Screenshot of the questions

```
// Generate AI questions and responses
void geminiFunctionCalling() async {
  String systemPrompt =
      'act as a doctor specifically for dancers. Provide an assessment of my symptoms and give me some advices';
  String userPrompt =
      'Please provide 10 yes/no questions related to ${widget.organ} as a json format'
      ' to assess my health. Please only return the json file. DO NOT type '
      'anything at the beginning or end of the json. The json should look like '
      'this {"questions":["question": <question>]}';


  final chat = model.startChat(history: [
    Content.text(userPrompt),
    Content.model([TextPart(systemPrompt)]),
  ]);
```

Figure 3. Screenshot of code 1

This screenshot shows a part of an application where a function named `Gemini Function Calling()` is defined. This function is asynchronous, which means it allows the application to

perform other tasks while it waits for a particular operation to complete, like getting a response from a server.

In the code, there are two string variables: `systemPrompt` and `userPrompt`. The `systemPrompt` instructs the app to act like a doctor specialized for dancers, giving an assessment and advice based on symptoms. The `userPrompt` asks the user to provide 10 yes/no questions in a JSON format about a specific body part, which will be used to assess their health [9].

The method `startChat` in the code is used to begin a chat or a session, likely with an AI model. This method takes a history that includes `userPrompt` and `systemPrompt` to guide the conversation. The `Content.text(userPrompt)` and `Content.model([TextPart(systemPrompt)])` seem to prepare and send this information to the backend or AI model.

When this code runs, it's during a part of my app where a user decides to start the assessment to diagnose their injury. The backend or AI model, upon receiving these prompts, generates specific questions based on the user's input and provide a system response based on the set-up logic in `systemPrompt`. This interaction is stored and processed further to give the user a detailed health assessment based on the provided answers and further medical advice like treatment options and prevention tips.

The image upload and diagnosis feature lets users upload a photo of their injury. It uses neural networks to analyze the image and help diagnose the injury [10]. This makes the diagnosis more accurate by combining the photo with answers from the user's questionnaire.

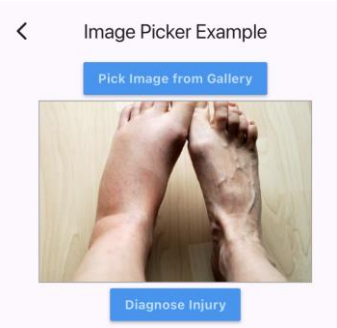


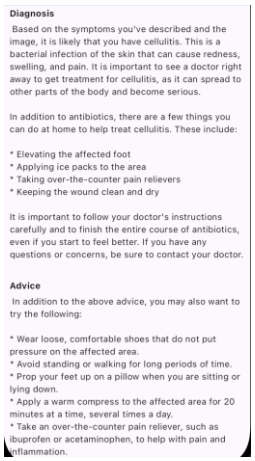
Figure 4. Screenshot of the example

```
Future getImageGallery() async {
  final pickedFile = await picker.pickImage(
      source: ImageSource.gallery,
      imageQuality: 80
  );
  setState(() {
    if (pickedFile != null) {
      _image = File(pickedFile.path);
      print("Image picked");
      //widget.imgUrl = null;
    }
    else {
      print("No Image Picked");
    }
  });
}
```

Figure 5. Screenshot of code 2

The diagnosis and advice page is displayed using answers from the questionnaire and photos, if applicable. It relies on image recognition and neural networks to interpret photos and

questionnaire data, providing accurate medical advice tailored to the user's specific injury. This ensures comprehensive and personalized recommendations for treatment and prevention.



Diagnosis

Based on the symptoms you've described and the image, it is likely that you have cellulitis. This is a bacterial infection of the skin that can cause redness, swelling, and pain. It is important to see a doctor right away to get treatment for cellulitis, as it can spread to other parts of the body and become serious.

In addition to antibiotics, there are a few things you can do at home to help treat cellulitis. These include:

* Elevating the affected foot
* Applying ice packs to the area
* Taking over-the-counter pain relievers
* Keeping the wound clean and dry

It is important to follow your doctor's instructions carefully and to finish the entire course of antibiotics, even if you start to feel better. If you have any questions or concerns, be sure to contact your doctor.

Advice

In addition to the above advice, you may also want to try the following:

* Wear loose, comfortable shoes that do not put pressure on the affected area.
* Avoid standing or walking for long periods of time.
* Prop your feet up on a pillow when you are sitting or lying down.
* Apply a warm compress to the affected area for 20 minutes at a time, several times a day.
* Take an over-the-counter pain reliever, such as ibuprofen or acetaminophen, to help with pain and inflammation.

Figure 6. Screenshot of advice

```
// geminiFunctionCalling method: Communicates with the Gemini model and sets the response.
Future<void> geminiFunctionCalling() async {
  // Start a chat with the generative AI model and send a message.
  final chat = model.startChat(history: [
    Content.text(
        'These are the response for the questions: ${widget.responses}'),
    Content.model([TextPart('Hello, How can I help you?')]),
  ]);


  // Ask AI to assess and give advice
  var message =
      'act as a doctor specifically for dancers. Provide an assessment of my symptoms and give me some advices';
  var content = Content.text(message);
  final response = await chat.sendMessage(content);


  // Update the result state with the model's response.
  setState(() {
    result = response.text;
  });
}
```

Figure 7. Screenshot of code 3

4. EXPERIMENT

4.1. Experiment 1

An AI's accuracy is a possible blind spot in my program. It's important that the AI gives the correct questions for a certain body part otherwise a dancer will get an incorrect diagnosis.

To test the AI's accuracy in my app, I can set up an experiment where I select a body part and see if the AI will generate 10 questions related to the chosen part. I will repeat this experiment for multiple body parts to ensure consistency. This straightforward test is set up this way to directly assess if the AI can accurately link the selected body part with relevant questions without using control data.

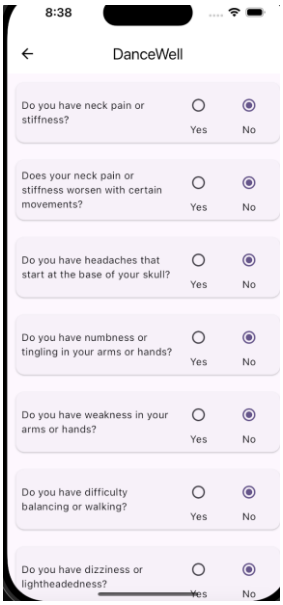


Figure 8. Figure of experiment 1

After I clicked on the cervical spine body part, the app led me to the page in 4.1C. The page asked 10 questions about the neck, which is accurate because the cervical spine is the neck area of the spine.

4.2. Experiment 2

An AI's accuracy in diagnosing injuries must be very accurate otherwise a dancer will receive an incorrect diagnosis, treatment option, prevention tips, and physical therapy videos.

To evaluate the AI's accuracy in diagnosing injuries within my app, I will conduct an experiment by manually inputting known dancer-related injuries into the app, using both the image upload feature and the 10 questions. I will then record the AI's diagnosis, suggested treatment options, prevention tips, and any recommended physical therapy videos. To assess the accuracy of the AI's responses, these results will then be compared with assessments provided by a qualified medical professional who will review the same injury cases. This comparison will help determine how closely the AI's responses align with professional medical advice, ensuring that the app provides safe and reliable information for dancers.

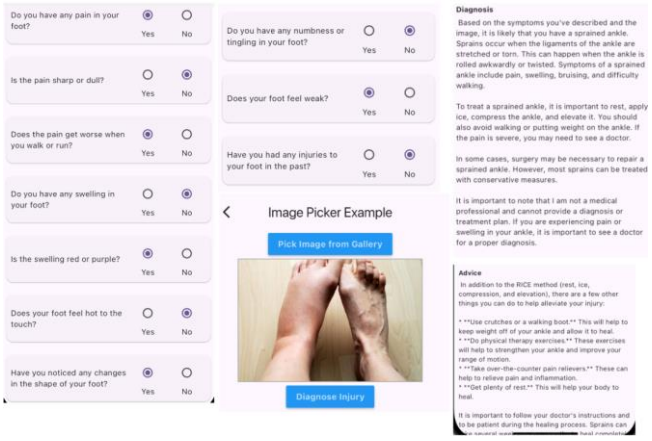


Figure 9. Figure of experiment 2

I haven't had the chance to talk with a medical professional, but the diagnosis doesn't seem too far off. One thing I noticed is that in the 10 questions, I said there was no swelling but then said the swelling was red or purple in the previous question. I could add a follow-up if the user provides contradicting answers so the AI doesn't get confused.

5. RELATED WORK

I couldn't find sources that directly relate AI and diagnosing dance injuries, but this source discusses traditional methods for diagnosing and treating common dance injuries, focusing on physical exams and personalized treatments based on observed symptoms [11]. While it's effective in addressing visible and common symptoms, this approach may overlook subtler, underlying issues that aren't evident without advanced technology. It also relies heavily on subjective assessments, which can vary between practitioners.

My project uses AI to complement these traditional methods, enhancing diagnostic accuracy and consistency by analyzing patterns from a broader range of data, including past injury cases and outcomes. This integration aims to reduce the subjectivity in diagnoses and provide a more comprehensive understanding of dance-related injuries.

In the study, AI analyzes past dance injury data to predict risks and suggest prevention strategies [12]. It's effective because it helps dancers avoid injuries by learning from previous cases. However, it might not always be accurate because it doesn't fully account for individual differences among dancers, such as their physical attributes or unique dance styles. This approach also relies heavily on historical data, which might not fully represent all possible injury scenarios. My project seeks to enhance this by using real-time data from wearable technology, offering a more personalized and immediate understanding of injury risks tailored to each dancer's current condition.

The article discusses AI's role in diagnosing diseases, highlighting its ability to process large amounts of medical data quickly and accurately, which can sometimes outperform doctors [13]. However, patients often don't trust AI because it lacks the human touch and understanding that doctors provide. Also, AI decisions can be hard to understand, making people wary of relying on its guidance.

The solution's effectiveness is evident in its precision and efficiency, but its limitations include a potential lack of empathy and transparency. AI might ignore the emotional and psychological aspects of patient care, which are crucial in medical treatment.

My project aims to improve upon this by making AI more transparent and integrating it with care provided by human doctors. This approach helps patients feel more secure because they understand how AI contributes to their diagnosis and treatment, ensuring that the technology supports, rather than replaces, the human aspect of healthcare.

6. CONCLUSIONS

The article discusses AI's role in diagnosing diseases, highlighting its ability to process large amounts of medical data quickly and accurately, which can sometimes outperform doctors. However, patients often don't trust AI because it lacks the human touch and understanding that doctors provide. Also, AI decisions can be hard to understand, making people wary of relying on its guidance [14].

The solution's effectiveness lies in its precision and efficiency, yet it faces challenges including a potential lack of empathy and transparency. AI may overlook the emotional and psychological dimensions of patient care, which are integral to effective medical treatment.

To address these concerns, my project enhances AI transparency and integrates it with care provided by human doctors. This dual approach reassures patients by clarifying AI's role in their diagnosis and treatment, reinforcing that technology is a complement to, not a replacement for, the human touch in healthcare.

My app, designed for injured dancers, offers diagnoses and recommended actions based on their answers to 10 targeted questions and, potentially, a photo. While waiting for a consultation with a sports doctor, users can begin appropriate exercises suggested by the app to alleviate their symptoms. However, the app currently has limitations, including the inability to link a user's injury history to their profile and the lack of functionality to upload photos directly through the app. These are areas we are looking to improve to enhance user experience and provide more comprehensive support[15].

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