Aurora 2024: Project Proposal Template for University Competition

Project Title: VitaCam: Vitamin Deficiency Detection Using AI

Project Idea:

We're developing an app to identify vitamin deficiencies in the specific age limit of Sri Lankan people.

Our app is tailored exclusively for Sri Lankans, focusing on identifying vitamin deficiencies within specific age ranges. Where many people lack proper nutrition due to economic challenges. This app will help quickly spot who needs more vitamins, especially in remote areas where access to healthcare is limited. By using advanced technology like Generative AI and Image Processing, we aim to make this app easy to use and affordable for everyone.

Problem Statement:

In Sri Lanka, many people are becoming malnourished because of the economic crisis. This means they're not getting enough vitamins, which can lead to health issues. We want to focus on this problem of not having enough vitamins in our community.

Challenges:

1. Figuring out a fast and accurate way to find and fix vitamin problems without needing lots of expensive tests.
2. It's hard to tell the difference between different vitamin problems because they can have similar symptoms.
3. Making sure everyone can get help for their vitamin issues, especially if they live far from doctors.
4. Using fancy technology like image processing and Generative AI to make it easy for people to know if they have vitamin deficiencies.

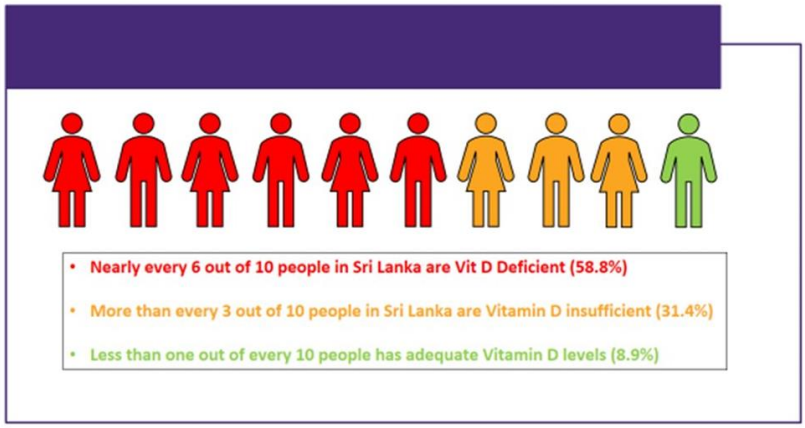
Why it Matters:

Not having enough vitamins can cause a lot of problems for people, from feeling sick to having serious health issues. If we can catch these problems early, we can help people stay healthy and save money on healthcare.

Who it Affects:

1. People: Not having enough vitamins can make people feel sick and less productive.
2. Healthcare: If we can find a good solution, it'll be easier for doctors to help people with vitamin issues.
3. Society: When people are healthier, they can work better and help their communities more.

Example Impact:



https://www.epid.gov.lk/storage/post/pdfs/en_641011177e0c3_Vol_50_no_09-english_1.pdf

Existing Solutions:

Right now, most tests for vitamin issues are expensive and hard to access, especially in poorer areas. Some apps use AI to help, but they're not always accurate or easy to use. We want to make a better, simpler way for people to check their vitamins with VitaCam.

Solution Overview:

Our goal is to ensure that everyone maintains good health, which is crucial for achieving the world's Sustainable Development Goals. With this aim in mind, we are prepared to deliver the solution directly to your fingertips through our VitaCam. It is a cutting-edge mobile application designed to revolutionize the assessment and management of vitamin deficiencies. By allowing users to upload images of specific areas like nails, skin, face, tongue, scalp, eyes, and teeth, VitaCam utilizes advanced image processing and AI algorithms to analyze potential signs of various deficiencies.

- Directly Address to Identified Problem

It provides an efficient, accurate, and cost-effective method for identifying and managing nutritional deficiencies.

- Creativity and Originality of the solution

Integrating image processing and Generative AI technology into a mobile application for vitamin deficiency assessment represents a novel approach to addressing nutritional health disparities. VitaCam's innovative use of visual cues for diagnosis offers a non-invasive and convenient alternative to traditional laboratory tests, enhancing accessibility and affordability for users.

- Positive Impact on the Community

Create a positive impact within the community by promoting early detection and intervention for vitamin deficiencies. By empowering individuals to proactively manage their nutritional health, VitaCam can prevent long-term health complications and improve overall well-being.

- Real-Life Scenarios

Someone living in a remote area with limited access to medical facilities can use VitaCam to assess their nutritional status and receive personalized treatment and dietary change recommendations.

- Key Functionalities
    1. Image upload and analysis for assessing potential signs of vitamin deficiencies.
    2. Personalized diagnostic results detailing identified deficiencies and associated symptoms.
    3. Treatment recommendations are presented as text and voice prompts for medication and dietary changes.
    4. Gives customers comprehensive descriptions of deficits found, along with possible symptoms

Project Scope:

Boundaries of the project

Our app focused on detecting a carefully selected **range of common vitamin deficiencies within specific regions of the body**. These deficiencies are chosen based on the feasibility of detection through image processing.
The vitamin deficiencies that the app can identify,

- Vitamin A
- Vitamin E
- Zinc
- Iron
- Biotin
- Vitamin C
- Vitamin D

Body part Identified	Vitamin deficiency that can identified
Eyes	Vitamin D, Vitamin A, Vitamin E
Teeth	Vitamin C
Tongue	Vitamin K, Iron
Nails	Zinc, Biotin

Body part Identified	Vitamin deficiency that can identified
Scalp	Biotin
Skin	Vitamin A, Vitamin E, Vitamin C

What will our project achieve and what will it not cover?

Using VitaCam, users can accurately detect vitamin deficiencies in the face, tongue, eyes, teeth, nails, skin, and scalp but in this first release, they cannot detect vitamin deficiencies in other body parts such as Lips, Mouth, or Oral cavity, Hair, Ears, Joint, etc...

While this application can provide insights into vitamin deficiencies based on visual indicators, it will not replace professional medical diagnosis.
In case of urgent health concerns or severe symptoms, it only suggests seeking medical assistance. The app will not provide emergency medical assistance.

We will develop an app that can identify only specific vitamin deficiencies. Due to limitations in image processing technology and the complexity of nutrition health, the app may not detect all possible vitamin deficiencies.

Target Audience

The primary target audience of the VitCam includes,

- Who may experience symptoms that indicate a potential vitamin deficiency.

The overall target audience of our application is,

- All People who want to monitor their nutritional status. (The accuracy of the results will be higher for individuals aged between 15 and 45.)

Generative AI Approach:

APIs

- USDA food data central API: for recommending foods based on vitamin deficiency.
- MedScape API: to get medical information

Generative AI models
1. MedGPT(https://medgpt.co/)
Generate text to display vitamin deficiency after analyzing the images and
Generate text to give a medicine list according to vitamin deficiency.

2. Generate audio to give advice and guidance to improve vitamin levels (good health habits)
First, generate text and convert that text to audio using Google Text-to-Speech

Use Google Text-to-Speech to generate audio (we don’t show generated text to the users).

Technical Approach:

For the technical part. We can divide it like this.

1. Prototype
2. Front end
3. AI models
4. Backend

1. Prototype

Tool: Figma

Figma is utilized for creating prototypes to visualize the design and user interface of the mobile application.

2. Front end

Framework: React Native

Language: JavaScript (React.js)

IDEs: Visual Studio Code, Android Studio

Description: React Native framework is chosen for its seamless integration with AI functionalities. JavaScript, particularly React.js, is employed for front-end development, ensuring a responsive and intuitive user interface. Visual Studio Code and Android Studio are used as integrated development environments for coding and testing.

3. AI model

In this application we are going to use two AI models, one for analyzing images and deciding vitamin deficiency and another one for generating text to predict labels of deficiency.

AI-01

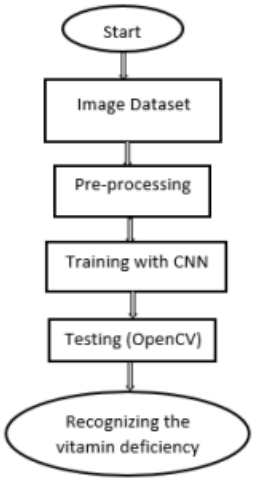
3.1. Model architecture

- Image acquisition: Image acquisition is the step where the vitamin deficiency images are taken as input.
- Image pre-processing: The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features that are important for further processing.
- Image segmentation: Image segmentation is the process of partitioning a digital image into multiple segments. Partitioning is done by k means clustering

  Steps for K mean clustering:

  - Randomly select 'c' cluster centers.
  - Calculate the distance between each data point and cluster center.
  - Assign the data point to the cluster center whose distance from the cluster center is the minimum of all the cluster centers.

- Feature extraction: The aim of feature extraction is to find out and extract features that can be used to determine the meaning of a given sample.
- Classification: In this phase to detect and classify vitamin deficiency, we are using the classifier which is a support vector machine.



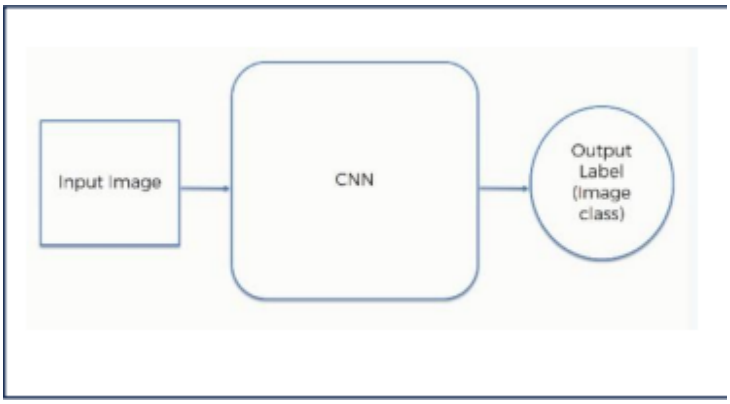
AI model architecture

Train data: for the train data we are going to collect healthy images as well as affected images

Example image of the dataset

3.2. Algorithm

CNN-convolutional neural networks we are going to use to achieve this task effectively.



To integrate the AI model into the mobile app implementing a web hook.

Framework: TensorFlow

Language: Python

IDE: PyCharm

Description: TensorFlow, a powerful machine learning framework, is employed for developing and training the AI model using Python. The model is trained using CNNs.

Backend

Framework: Django

Language: Python

Deployment Tool: AWS

Description: Django, a Python-based web framework, is chosen for the backend development, as it seamlessly integrates with the AI model in the mobile app. AWS is utilized as the deployment tool for hosting and managing the backend infrastructure.

APIs
-USDA food data central API: for recommending foods based on vitamin deficiency.
-MedScape API: to get medical information

Other tools

TTS: to choose different voices and adjust settings such as speed, pitch, and volume**.**

Future Work:

1. We aim to make our app accessible to people worldwide, allowing users from diverse backgrounds to utilize its features and obtain results seamlessly.

2. In the future we plan to enhance the functionality of the app that can be used to detect vitamin deficiencies in other body parts such as Lips, Mouth or Oral cavity, Hair, Ears, and Joints.

3. In our generative AI approach, we plan to generate voices using Sinhala and Tamil languages, integrating multi-language functionalities.

4. We plan to integrate a feature that allows the camera to capture images in real time within the application and upload them.

References:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6265675/
Cynthia Hayat, Barens Abian, "The Modeling of Artificial Neural Network of Early Diagnosis for Malnutrition with Backpropagation Method", 2018.

https://medgpt.co/

https://fdc.nal.usda.gov/api-guide.html

https://www.healthline.com/nutrition/vitamin-deficiency

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