SMART INDIA HACKATHON 2023

1 . Edition / Category (Hardware or Software) : Software (Problem Statement ID : SIH1344)

2 . Sector / Theme : MedTech / BioTech / HealthTech

3 . Title of Problem Statement : Al-based tool for preliminary diagnosis of Dermatological manifestations .

4 . Background (short description) :

The Global Burden of Disease project has shown that skin diseases continue to be the 4th leading cause of nonfatal disease burden worldwide . These conditions are often the presenting face of more severe systemic illnesses , including HIV and neglected tropical diseases (NTD) such as elephantiasis and other lymphedema-causing diseases . Additionally , skin disorders pose a significant threat to patients' well-being , mental health , ability to function and social participation . However , it is very difficult to provide better dermatological care to under-served or resource-poor regions in a cost-effective manner owing to unavailability of efficient diagnostic tools , lack of connectivity and poor laboratory infrastructure etc . Moreover , there is also a scarcity of physicians with dermatological training . Even , preliminary screening of a dermatological manifestation seems to be an arduous task . Thus , developing an Artificial intelligence-based tool (through Image processing technique) for preliminary diagnosis of numerous dermatological conditions will prove to be a boon in the health care system .

5 . Solution to Problem Statement :

The proposed solution majorly contains **four** proposed algorithms to our proposed solution towards designing an AI based chatbot assistant which are described below with required major functionalities :

- **Keyframe Selection & Skin Image Processing :** Video frames of a skin condition in case of video input along with image input option is taken . Calculate frame similarity with other frames using a cosine similarity metric :

  Cosine Similarity(Frame1 , Frame2) = (Frame1 * Frame2) / (||Frame1|| * ||Frame2||)

  along with Calculate modularity (Q) of the graph where **δ(c(i) , c(j))** is the **Kronecker delta function** :

  Q = Σ [e(ij) - (a(i) * a(j) / (2m))] * δ(c(i) , c(j))
- **Fine-Tuning the ResNet-50 Model :** Creating a sequential model " model " & add layers :

  model.add(layers.Dense(units , activation = 'relu'))

  model.add(layers.Flatten( ))

  Train the model with the dataset . The loss function can include classification loss that is Categorical Cross -Entropy & regularization terms that is L2 regularization :

  Loss = ClassificationLoss + λ * L2RegularizationTerm
- **Fine-Tuning the BioBERT Model :** Used for question-answer embeddings . It included calculating Cosine Similarity between the question & answer embeddings :

  CosineSimilarity(QuestionEmbedding , AnswerEmbedding) = (Q * A) / (|| Q || * || A ||)
- **Amalgamation of Embeddings & GPT-2 :** Used for text & image embeddings , User Questions , Pre-computed question-answer embeddings with output GPT-2 model with Context-Aware Learning & Weighted Loss Mask (WLS) .

$$\text{Concatenated Embeddings (CE)} = [E_T, E_I] \qquad LM = \sum_i CS_i \times \text{Weight}_i$$

Weighted Loss = LM × Loss

6 . Outcome Expected :

- Generate answers to patient queries .
- Insights & similar questions with answers derived from a vast amount of medical historical data , improving the quality of diagnosis & recommendations .
- Voice-based interaction with the chatbot for added convenience .
- Integration of Google Translator API for regional language translation for wider accessibility of Multi-Lingual Support .
- Utilize image processing techniques & potentially integrate a separate image based model to interpret & respond to medical image related queries & data .
- Ensured data security & patient privacy through robust encryption algorithms .
- Use of context-aware learning in responses for more relevant & informative answers .

7. References:

- Radford, A., Wu, J., Child, R., Luan, D., Amodei, D., & Sutskever, I. (2019). Language models are unsupervised multitask learners. *OpenAI blog*, *1*(8), 9.
- Lee, J., Yoon, W., Kim, S., Kim, D., Kim, S., So, C. H., & Kang, J. (2020). BioBERT: a pre-trained biomedical language representation model for biomedical text mining. *Bioinformatics*, *36*(4), 1234-1240.
- Jones, A., Caswell, I., Saxena, I., & Firat, O. (2023). Bilex Rx: Lexical Data Augmentation for Massively Multilingual Machine Translation. *arXiv preprint arXiv:2303.15265*.
- https://github.com/re-search/DocProduct