SriHealth: A Single Platform for Meal Plans, Workouts, Yoga Schedules Based on SriLankan Lifestyle

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***Abstract*—Food is a fundamental piece of human existence. People have forgotten to follow good eating patterns and exercise goals because of today's fast-paced lifestyles, resulting in malnutrition, which has become one of the most serious public health issues in developing countries, including Sri Lanka. As a result, people are unable to adhere to a probable schedule to satisfy their desires intend for Sri Lankan cuisine. In this study, a mobile-based application named "SriHealth" is developed with an emphasis on Image Processing, Natural Language Processing (NLP), Classification and Regression in Machine Learning techniques. The results obtained show that for classification of food preferences identification produces high accuracy of 87% on Support Vector Machine (SVM) classifier, medical record breakdown comprises of 75% accuracy with Clustering through Logistic Regression, schedule provider consist of an 95% accuracy level in Naïve Bayes algorithm while the calorie counter provides an accuracy level of 73% in MobileNet. The proposed work would identify user food preferences and medical conditions, classify the user, provide the suitable meal plan, exercise and yoga plan schedule on their categorization, and measure the number of calories consumed while assisting them for a healthy life.**

Keywords— Cuisine, Machine Language, Meal Planning, Natural Language Processing, Sri Lanka

I. INTRODUCTION

The world is affluent with numerous dieting applications, but they do not cater to the needs of the Sri Lankan dieting systems. The prevailing European and American dieting applications hardly offer a satisfactory result for the people in Sri Lanka who enjoy rice and curry for all three meals. According to a rough survey conducted by the researchers the results have shown that many Sri Lankans suffer from Non-Communicable Diseases (NCD). It shows that 34% of deaths in Sri Lanka caused by cardiovascular diseases, followed by cancer and other Non-Communicable Diseases (NCD)[1].

Among those Non-Communicable Diseases (NCD) obesity has become very common among people between 20 to 60 age group. To overcome this problem there is a tendency to use various methods including dieting applications. According to the cultural, economic and geographical backgrounds the expected results cannot be gained. Many ends up discouraged and discontented. Influenced by the studies, the proposed system, SriHealth helps improve Sri Lankan lifestyle. It is embedded with Image Processing, NLP and Machine Learning techniques to enhance the users' best practice. The system SriHealth consisted of four main models namely NLP based chatbot, Medical Record Breakdown using Machine Learning techniques and Image Processing, Schedule Provider and Calorie Counter. The proposed system will be launched with the intention of obtaining wealthy health for Sri Lankans. Those who suffer from Non-Communicable Diseases (NCD) will be effortlessly benefited by this application.

At the first step NLP based chatbot will identify the users' food preferences and categorize the user. Then at the next component, Medical Record Breakdown, users' medical records will be analyzed and ranged. At the third component, according to the previously analyzed and ranged value of the medical record, a meal plan, yoga plan and exercise schedule will be provided. The final component Calorie Counter will count the total calorie of the users' meal through Image Processing.

II. LITERETURE REVIEW

In this section authors have conducted a literature survey to get more familiar research done earlier. Given below are some of the prominent researches relating to our research study.

In research done by Shilpa Dharkar and Anand Rajavat discovered that a performance analysis of a healthy diet recommendation system [2] that suggests the food that is beneficial to an individual's health. The purpose of this research was to build and implement a system based on web data mining techniques that would be relevant in defining patterns. In terms of accuracy and time performance analysis, the ID3 and C4.5 decision tree classification algorithms were applied in the system to evaluate the healthy diet data set. According to their comparisons, ID3 produced more accurate results than C4.5, since it does not work with each instance after being applied to the program for healthy diet recommendations. As a result, the classification accuracy in C4.5 was greater. This research paper assisted in identifying the classifier performance evaluation approaches that can be applied according to the dataset.

Research conducted by Nandish Shah and Ishani Shah presented a proposal for a system for healthy eating and food

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habits [3] based on web data mining, determining hidden patterns and business strategies from users and web data, which will monitor eating habits and recommend foods that improve health while avoiding illness by consuming risky food types. Authors used data mining algorithms such as classification, clustering, association rules, and so on to extract meaningful information about a person's eating habits. The nutritional structure of each type of food was studied, and the calorie, fat, and vitamin content of the meal were computed. The data was then processed using classification algorithms, and the findings were reported to determine whether the food was healthy. As a result, recommendations were made to each individual.

In 2016, Prof. Sachin Gavhane has led to develop a fitness consultation system called the 'Fitness Advisor', [4] which is a desktop application that advises the user on the effective diagnosis of his or her weight-related problems as well as adequate information about medical concerns. The authors considered various parameters, including weight, height, gender, body type, state of health, physical activity, and bedtime, and then a combination of clustering, association, and classification algorithms to deliver the best expert advice for the user's problem. The authors used the Apriori algorithm to generate association rules, and also the system's overall outcome was diet and exercise advice from experts.

According to the research analysis done by R. Divya, S. Vithiya Lakshmi, and Mrs. S.L. Jayalakshmi, those that developed a system [5] to monitor diet and analyze health to categorize the disease for the user by obtaining their details including name, age, height, weight, and so on through achatbot interaction. It also provides a diet plan for the user to improve their health through classification algorithms based on Bayes' theorem along with the feature matrix and response vector.

Furthermore, a study done in 2017 May [6] by Abhinav Sathiamoorthy, Mayur Bangera, Bhawana Chaudhary, Asmita Shejale, Nimisha Darira developed an application called 'Virtual Dietician' that help people of all age groups and lifestyle but especially for those who lead a sedentary life and do not get time for physical activity and to maintain their health. Through this application user data was taken and then calculates the cost function considering various factors like availability, popularity, protein content, fat content, carbohydrate content of the food items and gives the appropriate diet to the user (Monitoring Diet) with the use of Image Recognition, Pattern Matching and Recognition algorithms, Natural Processing techniques in order to give an appropriate diet to the user. However, work out and other sessions of the user could not recommend.

Analysis and Design for Food Planning Mobile Application [7] In this, it has suggested an app for food planning. This system allows us to plan the meals to the users, and it also helps to manage the food plans and recommends food that is good to consume. This mobile app is implemented on both android and IOS platforms, which is really helpful for both users. Not only food recommending, but this application also suggests a menu for the restaurants. Even though this system recommends a balanced diet, this system lacks some sections in the app. It will be better if the application is more user friendly than the current one.

An early work by Heba A. Kurdi, Arwa Alkhowaiter, Arwa Al-Muaibed, Bodor Alotaibi, Roa'a Alhaweal, Taghreed Alotaibi proposed a system of mobile healthcare application for personal diet assisting. Researchersmainly aim in this paper about contributing to the worldwide effort in tackling the obesity problematic by introducing a mobile diet assistant application (myPDA) that increases the awareness of balanced diets and also, researchers encourage users by giving healthy plans and promotes to increase the exercise levels. Researchers provide that application by giving features to the users like creating a profile and sharing it through dietitians, tracking weight, choosing a diet plan. However, researchers planned to do some future tasks [8].

Another work by David Ribeiro, João Machado, Jorge Ribeiro, Maria João M. Vasconcelos, Elsa F. Vieira and Ana Correia de Barros proposed [9] Mobile meal recommender system for older adults. From this research authors provided a mobile meal recommender system (SousChef) for older users, and authors mainly created meal plans based on the details that the user provided. Researchers consider about user's personal preferences, anthropometric measures and activity levels. By doing this research at last their results showed more than 70% older adult users were satisfied with the meal plans that provided.

Somaye Norouzi, Azade Kamel Ghalibaf, Samane Sistani, ahideh Banazadeh [10] proposed another research called a food recommender system to manage diabetic patients. This system includes an artificial intelligence technique. The researchers develop this system according to the patients' favorites and conditions. Mobile application was developed as a knowledge-based system. 79.44% accuracy were showed from this system.

Image processing-based scene-text detection and recognition with Tesseract [11] shows how the use of Tesseract can be used to identify an image. Medical Record Breakdown (MRB) model uses Tesseract to extract the data from the image and store them. Further MRB is used to identify the users' health conditions.

III. METHODOLOGY

The current version of the mobile application is organized in four different components Figure 1.

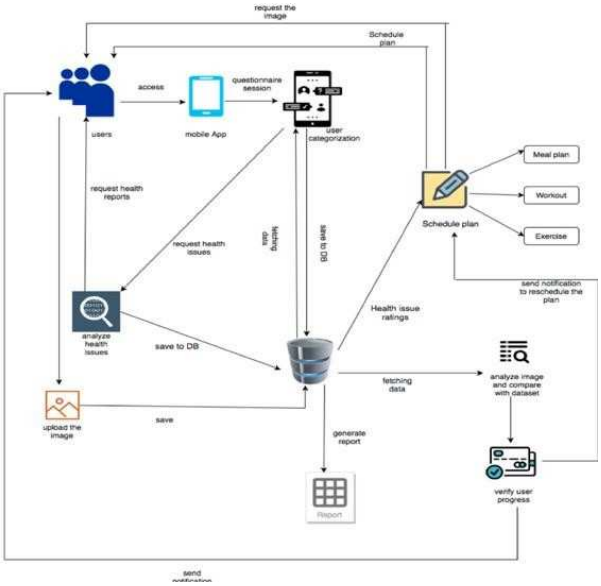

Fig.1. System Architecture

A. User Food Preferences Identification

This proposed component focuses on the user food preferences identification after the interaction done through the chatbot model. As this is a text recognition section, text classification applying with NLP is primarily used [12].

Mainly the chatbot makes ease the process of suggesting the meal plan and exercise plan. For that purpose, the user information is collected as gender, weight, height to calculate the Body Mass Index (BMI) status, dietary restrictions, food allergies, dislikes etc. According to those responses specified through chatbot conversation, user is given a category number out of the 18 categories. A category represents the details of gender, BMI status and dietary restrictions. Then the category number along with the other details are passed to the meal plan provider component to plan meals correctly and healthily.

The data set included the relatable personal consuming habits, health conditions which were collected from the pilot survey [13] using a Google Form that was sent to a random set of age groups and gathered 214 responses. The results showed most people are currently not following a health instructing app or following a meal plan and around 12% of them were had an average exercise level. The data set was further proceeded under the guidance of an expert (nutritionist).

Following that, the entire dataset over 400 text data records, included in the.csv file was randomly divided into training (80%) and testing data (20%). A comparison was done with the algorithms Naïve Bayes, SVM and KNN. When using the NLP preprocessing pipeline for chatbot model, first tokenization is applied to the whole sentence, then split the sentence into different words, exclude punctuation characters and converting phrases to lowercase to create the training data. Finally, this trained model will be saved and then used in chat function and then implement the actual chat.

B. Medical Record Breakdown

MRB is supposed to be a useful model to identify the users' health condition. To make MRB more accurate, the researchers use Image Processing and Machine Learning techniques. In the first hand, the user is asked to submit his or her medical report which includes blood pressure, cholesterol level, blood sugar level etc. Blood Pressure, diabetes, arthritis, kidney failure and cholesterol are the most considered health hazards in this MRB model. The above- mentioned health hazards are given ratings from 0 to 10 under the consultations of experts in the medical field. The middle figure number 5 is considered the most favorable value for all health hazards. Both 0 and 10 are the unhealthiest values. Those who obtain these two values are noted as who needed extreme care. The obtained value of the user here will be passed to the next model.

The user is asked to submit the medical record as an image by the system. That image is totally read by Tesseract, a well-known open-source text recognition engine. The extracted data from the image is stored as a text file in the database. The required strings expected by the MRB is filtered through Python. That string will be rated under the above-mentioned ratings by Clustering through Classification. And that value is passed to the next model. The next step is to train the MRB model to find accuracy by using Logistic Regression [14] which is a Machine Learning Algorithm. The dataset of 500 records is split into two sets as Training (80%) and Testing (20%) sets and the dataset was generated randomly by using python by the researcher.

C. Provide a Meal Plan, Exercise Schedule and Yoga Schedule to the User

The proposed system includes three sub sections, and they are providing a meal plan, an exercise schedule and a yoga schedule to the users. All these parts are based on Sri Lankan Lifestyle. To provide those three to the users, this component receives data from the previous components, such as the preferences of the users and the health conditions of the users. User preferences come as a category number and the health condition of the user comes as a rating. According to these categories and the rating, a Sri Lankan meal plan, Exercise schedule and a Yoga schedule are given to the users. Before the implementation, conducting interviews with a doctor and with a fitness coach to gather more information about meal plans and exercise schedules were necessary [15].

It was difficult to find a proper data set for each three sections in this component and as a result of that problem, three data sets were created manually according to the requirements of the component. As the main part of the component, providing a Sri Lankan based meal plan to the users, a classification model was used to train the meal plan data set. This data set has six hundred records and when creating the data set manually, after analyzing the user preferences and user's health conditions, a meal plan number was given to each user. Those meal plan numbers and the meals that are included in the meal plan were created under the guidance of a doctor. When splitting the data for the model, 70% of the data has been used to training and 30% of the data has been used to testing. Random Forest, Support Vector Machine, Naïve Bayes and Decision Tree algorithms were used to obtain the highest accuracy. Among those algorithms Naïve Bayes Algorithm gave the best accuracy which was 95%. As the other two sections of this component, an exercise schedule and a yoga schedule were recommended using machine learning algorithms. These two sections were implemented according to the same algorithms such as Random Forest, Naïve Bayes and Decision Tree Algorithm, Support Vector Machine and Decision Tree. Among those algorithms, for the workout schedule provider, Naïve Bayes gave the best accuracy which was 99% and for the yoga plan provider Naïve Bayes algorithm gave the 98% of accuracy. According to the accuracy results, Naïve Bayes model was selected for those three sub sections of the component.

The users get a meal plan and workout or yoga schedule by analyzing their preferences and health conditions. Each user gets a profile that shows all those details. It encourages the user to stay healthy. As Sri Lankans it's better to know about the calorie intake of the food that is consume each day. This system helps users to maintain a healthy diet and a healthy lifestyle.

D. Measure Calorie Counts Through an Image

The proposed system is designed to measure calories through an image. After the meal plan is provided according to the schedule (according to the schedule provider step - C), the calorie counter model will count the calories of the meal plan through an image and confirm the total calorie intake of the user. In order to design the Calorie measurement system, various image processing and machine learning techniques are attached to this. First it found an image data set and calorie data set. It took more than 1000 food images with various type of Sri Lankan foods and get some images from the kaggle. And for calorie dataset it collected from a doctor. With the advice and the Information, a doctor helps to create that

dataset. In this component it includes 3 steps 1) Camera function development, 2) Object detection and segmentation ,3) Send notifications. In the following it explains these steps in more detail.

a) Camera Function

As the figure shows, at first stage images of food plates are captured by the users with the camera function that implemented in the mobile application. The camera function is developed in Android studio. Afterward users capture images by using this camera function. Users capture these images according to limitations to get size standardizations. Researcher capture these images to identify the plate that is with foods. Therefore, a bounding box is implemented in the camera function to do this process. The user captures these images on to a suitable size by using a bounding box Figure 2 Consequently, users can capture that image only after that bunding box came to the right position. Users need to capture images according to that limitation. If not, images could not be captured.

Fig.2. Bounding Box Display

b) Object Detection and Segmentation

This part plays a significant role in this system. And through this part if researcher can get an accurate result, it helps more to develop this system. In this segment it develops two models for object detection and for food segmentation. Object detection is a significant computer vision task that deals with detecting instances of visual objects of a certain class (such as humans, animals, or cars) in digital images. In this step it detects plate first by using object detection model. which is called MobileNet. It detects plate objects to identify the foods separately. When user capture according to the limitations, it identified the plate size and cropped the image. After the image is cropped it applies segmentation method to identify foods that are on the plate respectively Figure 3.

In here it trained a model to detect objects with the pixel counts. MaskRCNN is used when doing segmentation process. MaskRCNN is a straightforward, flexible and common framework for object instance detection [16]. From that it gets the pixel count of that food objects area. Calorie counts per pixel were stored in the database and after getting the pixel count of foods by using MaskRCNN it manipulates the pixel counts that stored in the database which is calories per pixel count. By doing this calculation at last it gives number of calories that user takes.

Calorie Count = Per pixel calorie count * pixel count of food area.

Fig.3. Segmentation Result

c) Send Notification

Finally, when calculations and measurements are done it checked and send a notification that the user has taken this total calorie count. Afterwards if that assigned calorie counts properly taken it sends a notification to the user by saying that the user takes this total calorie count. For do this it sends notification through the android application.

IV. Result and Discussions

In this section researchers discussed the results of the 4 models that trained. Researchers used K-means, Decision Tree, Support Vector Machine (SVM) Classifier, Logistic Regression, Random Forest, Naïve Bayes, Mobilenet, Resnet_101 and maskRCNN algorithms to train all four models. From the above algorithms researchers used Support Vector Machine (SVM), Logistic Regression, Random Forest, Mobilenet and maskRCNN due to their high accuracy. Table 1 shows the accuracy of models.

A. User Food Preference Identification

The accuracies of Naïve Bayes, SVM and KNN were 65%, 87% and 74% respectively. SVM was outperformed in classification of food preferences category identification, illustrated in Figure 4.

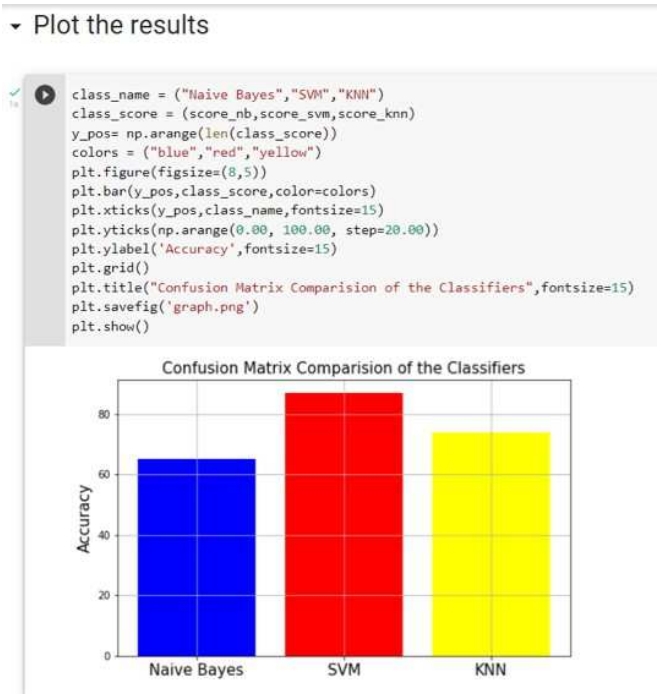

Fig.4. Accuracy Result

B. *Medical Record Breakdown*

Medical Record Breakdown Model was trained using Multinomial Logistic Regression algorithm, and it was able to obtain 74% of an accuracy Figure 5.

```
#Build a text report showing the main classification metrics

print(classification_report(y_test, predictions))
```

	precision	recall	f1-score	support
0	0.00	0.00	0.00	3
1	0.00	0.00	0.00	2
2	0.00	0.00	0.00	1
4	0.00	0.00	0.00	2
6	0.44	0.73	0.55	11
7	0.00	0.00	0.00	9
8	0.00	0.00	0.00	9
9	0.55	0.58	0.56	19
10	0.86	1.00	0.93	44
accuracy			0.74	100
macro avg	0.21	0.26	0.23	100
weighted avg	0.53	0.63	0.58	100

Fig. 5. Accuracy Result

C. *Provide a Meal Plan, Exercise Schedule and a Yoga Schedule to the User*

Providing a meal plan model was trained using classification algorithms and, it was able to obtain a 95% as the highest accuracy from the Naïve Bayes algorithm. Other than this model, 95% from the Support Vector Machine, 89% from Random Forest were received as the accuracy results Figure 6.

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
nb	Naive Bayes	0.9895	1.0000	0.9736	0.9935	0.9892	0.9851	0.9851	0.0330
svm	SVM - Linear Kernel	0.9895	0.0000	0.9712	0.9920	0.9886	0.9851	0.9851	0.1090
lightgbm	Light Gradient Boosting Machine	0.9871	1.0000	0.9625	0.9888	0.9859	0.9817	0.9817	1.2510
lr	Logistic Regression	0.9845	1.0000	0.9528	0.9865	0.9832	0.9779	0.9780	0.2120
lda	Linear Discriminant Analysis	0.8071	0.9977	0.6201	0.8149	0.7838	0.7258	0.7270	0.0450
ridge	Ridge Classifier	0.7811	0.0000	0.4808	0.7848	0.7600	0.6885	0.6898	0.0200
dt	Decision Tree Classifier	0.7332	0.8657	0.4573	0.7093	0.7049	0.6206	0.6217	0.0380
gbc	Gradient Boosting Classifier	0.7170	0.8439	0.3849	0.7229	0.7049	0.5993	0.6009	12.6610
et	Extra Trees Classifier	0.6985	0.9964	0.3920	0.6489	0.6553	0.5713	0.5726	0.2130
rf	Random Forest Classifier	0.6974	0.9964	0.3777	0.6627	0.6639	0.5696	0.5707	0.2380

Fig. 6. Accuracy Results of Naïve Based Algorithm

For the workout schedule provider section, Naïve Bayes showed the highest accuracy which was 99% and it displays in figure 7. Also, for the yoga provider section, there were a few models were used to obtain the highest accurate model and Naïve Bayes model gave the highest accuracy which was 98%. It displays in figure 8.

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
nb	Naive Bayes	0.9908	1.0000	0.9754	0.9940	0.9906	0.9866	0.9867	0.0340
svm	SVM - Linear Kernel	0.9893	0.0000	0.9714	0.9914	0.9881	0.9844	0.9845	0.1120
lightgbm	Light Gradient Boosting Machine	0.9884	1.0000	0.9689	0.9894	0.9869	0.9831	0.9832	1.3040
lr	Logistic Regression	0.9779	0.9999	0.9422	0.9822	0.9758	0.9679	0.9680	0.6480
lda	Linear Discriminant Analysis	0.8065	0.9978	0.6084	0.8233	0.7848	0.7188	0.7199	0.0530
ridge	Ridge Classifier	0.7732	0.0000	0.4554	0.7677	0.7503	0.6703	0.6717	0.0200
dt	Decision Tree Classifier	0.7560	0.8772	0.4859	0.7363	0.7293	0.6453	0.6463	0.0350
et	Extra Trees Classifier	0.7151	0.9966	0.4035	0.6626	0.6707	0.5859	0.5872	0.2430
rf	Random Forest Classifier	0.7146	0.9968	0.3920	0.6718	0.6767	0.5852	0.5863	0.2490
knn	K Neighbors Classifier	0.7037	0.9623	0.3669	0.6781	0.6769	0.5694	0.5703	0.1320

Fig. 7. Accuracy Results of Workout Schedule provide

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
nb	Naive Bayes	0.9540	0.0000	0.9134	0.9426	0.9468	0.9508	0.9521	0.0070
svm	SVM - Linear Kernel	0.9511	0.0000	0.9012	0.9429	0.9459	0.9476	0.9489	0.0120
rf	Random Forest Classifier	0.8966	0.0000	0.8296	0.8688	0.8783	0.8893	0.8922	0.0730
et	Extra Trees Classifier	0.8880	0.0000	0.8140	0.8636	0.8721	0.8802	0.8829	0.0690
dt	Decision Tree Classifier	0.8824	0.0000	0.7896	0.8576	0.8661	0.8743	0.8776	0.0060
lr	Logistic Regression	0.8737	0.0000	0.8046	0.8308	0.8449	0.8646	0.8685	0.4290
gbc	Gradient Boosting Classifier	0.8735	0.0000	0.8024	0.8337	0.8468	0.8644	0.8681	0.9920
lda	Linear Discriminant Analysis	0.8224	0.0000	0.8178	0.9004	0.8324	0.8142	0.8238	0.0100
ridge	Ridge Classifier	0.7648	0.0000	0.6448	0.6944	0.7178	0.7483	0.7536	0.0130
knn	K Neighbors Classifier	0.7245	0.0000	0.6068	0.6581	0.6783	0.7049	0.7134	0.0100

Fig. 8. Accuracy Results of Yoga Plan Provider

D. *Measure Calorie Count Through an Image*

For count calories of a meal at first, it is needed to detect the foods types of the image. Therefore, a model was trained using object detection API. ResNet 101 model was trained here with least accuracy. This model was not giving an accurate result Figure 8. Therefor it used MaskRCNN with segmentation to detect food objects.

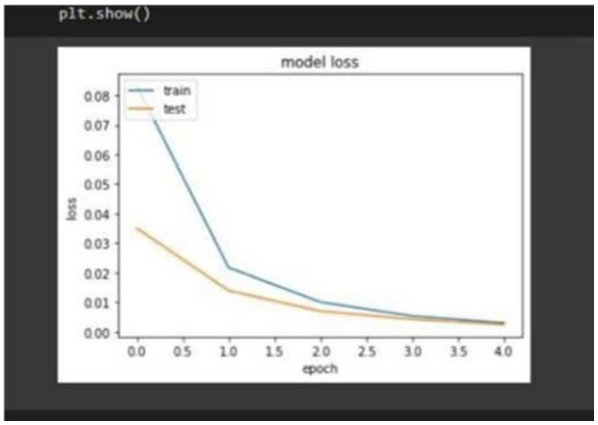

Fig. 8. Accuracy Results

TABLE I. SYSTEM COMPONENT ACCURACY

Component	Accuracy	Best Fit Model	Loss models
User Food Preference Identification	87%	Support Vector Machine Classifier	Naïve Bayes Classifier, KNN Classifier
Medical Record Breakdown	74%	Logistic Regression	Random Forest
Provide a Meal Plan, Exercise Schedule and a Yoga Schedule	95%, 99%, 98%	Naïve Bayes, Naïve Bayes, Naïve Bayes	Random Forest, Support Vector Machine
Measure Calorie Count through an Image	75%	MobileNet	Resnet101

V. Conclusion and Futurework

In conclusion, in this system a meal plan, exercise and yoga schedules providing mobile app called SriHealth, was presented, having as target audience Sri Lankan people. SriHealth is intended to act as a single mobile app that has everything on a single platform that guides Sri Lankan users into making wise decisions regarding a healthy lifestyle. This system will literally create a change in the daily habits of Sri Lankan people. Although in the literature survey, some recommender systems were mentioned and various applications are available already, even though there are similar applications researchers have found no similar mobile based solution designed for the Sri Lankans specifically.

The testing results of the components were very satisfactory with more than 70% of the accuracies considering following the meal plan suggestions, Workout and Yoga Schedules and use an application like the one presented here. Researchers are planning to develop the suggested system with more features, and researchers will be focusing on recommending doctors or nutritionists to provide a more trustworthy service to the users.

Acknologement

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