Grenze International Journal of Engineering and Technology, Jan Issue

Effective Mid-Day Meal Analysis Depending on Children's Needs using Machine Learning

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***Abstract*—Using state-level knowledge on India's Mid-Day Meal program our study tends to scrutinize if funds disbursed, and food ingredients equipped for the aim will really function as smart determinants of a variety of kids coated (fed) by the scheme. The influence of food (protein) equipment has a statistically significant impact on the variable amount, according to the study, but the statistical analysis of funds/money disbursed is also of utmost relevance. Analysis and prediction performance of regression models associated in nursing covariates ingredients is vital. Analysis of food ingredients along with Milk as an important component which is sectioned in primary and upper primary class is the approach of this study. To distribute the food according to the child's needs is crucial. In order to do that, the food requirement of every child needs to be understood and needs to be considered. K-Nearest Neighbour classifier was trained to predict what should be the amount of protein a child has to have in a meal. Similarly, another Logistic Regression model was trained as well in order to predict if the child is gaining from the food served or not. To check the quality of food, in this study rice, wheat and dry beans has been considered and various parameters for instance the area, perimeter, etc. have been taken into consideration in order to check if the supply of food ingredients by the government is up to mark or it still has some improvements to do.**

***Index Terms*— Mid-day meal, K-Nearest Neighbour classifier, logistic regression, front-end, milk and web application.**

I. INTRODUCTION

The age group from 4-16 is considered as a crucial age for the physical as well as mental growth of a child. Proper nutritional food is the key for achieving the desired growth in each aspect. With a population of more than 1.35 billion, India is the second-most populous nation in the world., (Source: Wikipedia), providing proper food is a task for our government. Children being the future of our country, their proper growth, and education are the main agenda here [1].

On August 15, 1995, India's 'National Program of Nutritional Support to Primary Education (NP-NSPE)' launched the Mid-Day Meal Scheme. This scheme provides one meal to all the children enrolled in government schools.

This program's goal is to enhance the enrolment in schools, providing nutritional support which will result in the increase of attendance in the schools. Although the initiative of the government was to come up with a way to

Grenze ID: 01.GIJET.9.1.10
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provide nutritional food and increase the number of children attending classes, the Mid-Day meal scheme has some flaws of its own. For instance, the quality and quantity necessary for a child to ensure proper growth is not delivered. So, with this study, we have analysed the working of MDM schemes. Analysis of the budget assigned by the government for the program is done considering the number of schools reported in the program from each state. Analysis about the nutritional requirement needed by the children (primary and upper primary) is carried out. Training the K-nearest neighbour classifier and the Logistic regression model, we were successful in providing the amount of protein and other food items to be delivered to a specific age group so that the child would gain proper mental and physical growth. A web app was created, and both these models were deployed on the front-end by exporting them as .pkl using pickle library and were hosted on localhost. This analysis will surely help the government entities to get proper insights regarding the food to be served.

II. Literature Review

Mr. Giridharan et.al. had reported a paper titled “Mid-Day Meal Analytics Using Machine Learning”. The goal of this proposed model is to avoid food loss from the mid-day meal programme and to discover fraud in the programme. A QR-code scanner is utilized in this technique to tally the number of students who have registered for food using their ID card within a given time window. The menu for a given day is displayed on a touch screen display at the food serving location. The volume of food that refers to a process for that day can be determined using a Webcam that is also placed at the location where food is distributed. This camera takes a picture of each pupil while simultaneously recording this same percentage of students present and the minimum number required. This image from a photograph is contrasted from a webcam at the location of the meal's preparation. The writers utilized the Raspberry Pi to analyse the machine learning idea to choose the food. They've also created a smartphone app that will notify a higher authority if a camera detects fraudulence in progress.[2].

Sinha et.al. had presented a paper titled MID DAY MEALS: A DETAILED STUDY OF INDIAN STATES. With a rising proportion of school-age children suffering from malnutrition, India established the Mid-Day Meal Programme (MDM) in 1995. As a result, the study article concentrates on the MDM Scheme in India. There is a persistent inequity in access to the Midday Meal Program throughout states and within states, as well as within income and social categories. As a result, the study intends to solve these difficulties. The study focuses on the interaction between the Midday Meal and school infrastructure. It also investigates disparities in MDM access in rural and urban locations, across boys and girls, and across income and social groups. Midday Meal, Social Groups, Infrastructure, Elementary Education are some of the key terms [3].

Ms. Savita Mishra et.al. reported a paper titled “Monitoring and Evaluation of Mid-Day-Meal Scheme in Sikkim ". The study's goals were to learn about the status of Sikkim's midday meal programme, as well as its monitoring and evaluation. Primary and secondary sources were used to compile the data. The research study was based on inspections of 11 governmental middle and high schools in Gangtok and the nearby areas that joined in the Mid-Day Meals Scheme. School Improvement Management Committee Schools, Generalized Observations throughout visits to Schools, control of meal service in schools, amount, and quality of meals, as well as other best - one of the greatest practices was the Midday Lunch Meal program [4].

Divya Kujur et.al. reported a paper titled “A study on Implementation of Mid-day Meal scheme during Covid-19 in Hazaribagh district, Jharkhand”. The study focuses on mid-day food plan patterns in the Hazaribagh district of Jharkhand during the covid-19 pandemic. While schools closed due to an active infection that was sweeping the globe, the research's aim was to understand more about how to organize a mid-day meal programme, as well as to investigate the reasons and how it has affected the beneficiaries. The study's goal was to learn about the problems they each face, whether the assistance offered is being used for the same purpose, and their degree of knowledge about the Mid-day Meal programme and its violations. Children are tomorrow’s hope, and they require sufficient nourishment and care. Education is necessary for progress, but the impoverished sections of society are unable to supply it to them. The guaranteed plan, which is sponsored by the Sarva Shiksha Abhiyan and the national child labour initiative, provides free of charge meal on Working-days while also improving nutritional levels among school-aged children. Several adjustments were made throughout the covid-19 period to make the Mid-day Meal Scheme easier to follow. As a result, the study reveals the current situation of the school's Mid-day Meal Scheme [5].

Mokhalles Mohammad Mehdi et.al presented a paper titled “Effectiveness of Mid-Day Meal Scheme (MDMS) in Primary Schools” in 2019. The goal of this review was to see how effective MDMA is in Assam's Golaghat district's Lower and Upper Primary schools. To carry out these research goals, secondary data was gathered from newspapers, scholarly journals, and government documents. To assess the effectiveness of MDMS in three

schools, a qualitative open-ended questionnaire was created. For a survey of the district's Food, Civil Supplies & Consumer Affairs department, headmasters/mistresses, and primary school children, a set of questionnaires was produced. The acquired analysis was performed using Excel tools to reach the conclusions. The findings of the study can be split into three groups: FCSCA Department; UP and LP school headmasters/mistresses; and UP and LP students. Continued adoption of MDMS will help to reduce child labour and ensuring that low-income children receive an education [6].

Manikumar T et.al had published a paper titled "Study on Mid-Day-Meal Analytics Scheme for School Children" in 2020. This research focused on the Mid-day Lunch Meal Plan, which is a government of India school lunch plan aimed at improving the nutritional status of school-aged children across the country. To oversee the Mid-day Meal Scheme's operations, student teams are to develop machine vision techniques. Therefore, it may be challenging to audit and supervise the project on a regular basis since the Mid-Day Meal initiative is implemented in schools across the nation. The following are examples of typical auditing and monitoring tasks: Ascertaining that the number of students who ate meals corresponds to the number recorded. The lunch provided is the same as the meal that was published/reported. Alerting in the event of a discrepancy and the opportunity to view historical records / proof (numeric and visual) for any school from a central location. Video streams will be offered to the scholar teams in order to style modules that support the above-mentioned tasks. [7].

Chetana Prabhat et.al. has reported a paper titled "Effect of Mid-Day Meal Programme on the Nutritional Status of School Children" in 2018. The goal of the study was to determine how a school-aged child's nutritional status and participation were changed by a noon meal. An anthropometric evaluation was done. At the time of data collection, standardized questionnaires were also used by the authors, which included demographic information for each student as well as a three-day meal recall Enrolment, participation, and information about the nature, quantity, and caloric content of the midday meal all were collected during data collection; additional statistics were then used to conduct in-depth analysis and assess the strength of the associations between the variables chosen for this study. The study demonstrates that children's nutritional value was subpar due to the economic circumstances of their family as well as other sociodemographic such as father's employment, parents' education, and genetic background. On the other hand, a mid-meal delivers enough micronutrients and around one amongst the calories needed to fulfil nutritional needs until lunch. Children's punctuality was extraordinarily high, and it was tightly linked to the noon meal [8].

D. Jayakumar et.al. had presented a paper titled "Mid-Day Meals Scheme Monitoring System in School using Image Processing Techniques" in 2020. The proposed paper includes a summary of Mid-day Meal and how it serves to improve school kids' nutritional status, as well as how this midday meal ploy provides students with free lunches on weekdays. The suggested work includes a monitoring system that employs a webcam to detect human faces, with picture recognition performed using an effective Viola Jones Algorithm. After verifying the faces, it uses a deep learning approach to check for food. Food identification and recognition estimation is performed here using the CNN learning method [9].

The Akshaya Patra website issued an essay with the following goals:

• Improving the nutritional intake of pupils in grades one through five at government, local government, and government-aided institutions, and also EGS and AIE centres.

• Motivating children from low-income families to attend school more frequently.

• During the summer break, providing nutritional support to primary school students in drought-stricken communities.

Akshaya Patra strives to meet two Sustainable Development Goals: Zero Hunger and Quality Education, while focusing on boosting nutritional levels and attendance [10].

III. METHODOLOGY

The Government of India started a school meal program called Mid-Day Meal scheme. This project is the analysis of Mid-Day Meal considering 24 states nationwide. Analysis and predictions of food ingredients for distribution of food in states in proper proportion is also part of this study. For analysis of the Mid-Day Meal program, data is made considering Schools, reported schools, Not reported schools, total funding, Funds needed, and Children covered over 24 states nationwide.

Schools: Total schools in the state

Reported: The schools which are reported to mid-day meal programme

Not reported: Schools which are not reported

Total funding: Total funding in crore Mid-day meal have for the state

Funds needed: Total funding in crore Mid-day meal need for the state
Children covered: The percentage of children covered if the funds needed is provided. Considering parameters of the data, analysis of mid-day meals started. Information about the condition of states is fetched through visualizations of the data. As per mid-day meal scheme, Primary Child requires 450 calories 12g protein per day and Secondary Child requires 700 calories 26g protein per day.

1. Gender, Height, Weight, and Protein: Analysis and predictions of protein is done by considering dependency of protein with gender, height and weight of child and the data is made. Through the K-Nearest Neighbour classifier with K value 5 from ski- kit learn, weight class is predicted considering the age, gender, height, and weight of the child and according to the classified weight class protein requirement in grams is predicted. was chosen for the same. This prediction model is exported using the pickle library and deployed on the front-end.

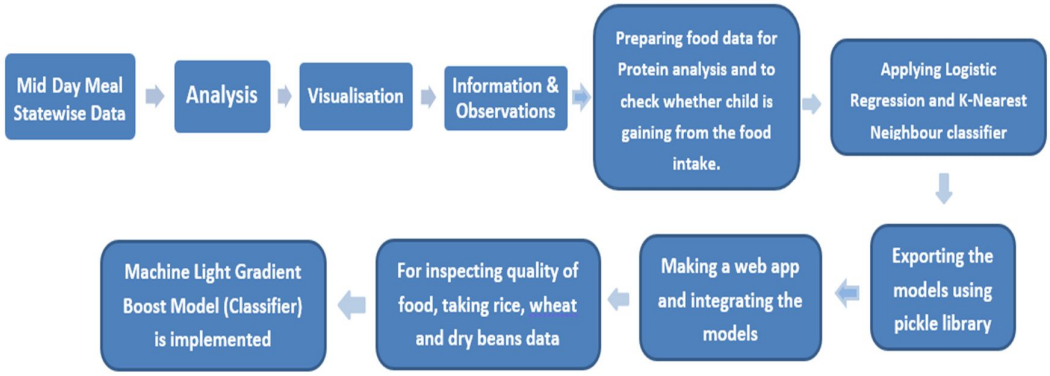

Figure 1. Workflow of the proposed model

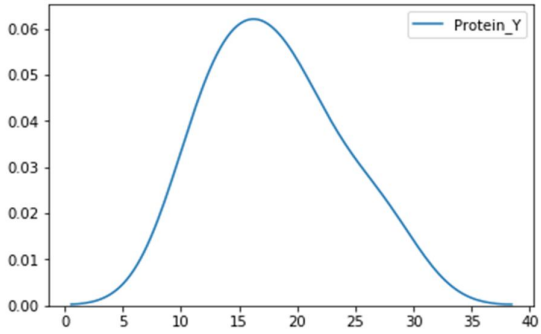

Figure 2. KDE-Plot for distribution of protein according to age

2. Gender, Height, Weight, and Protein: Analysis and predictions of protein is done by considering dependency of protein with gender, height and weight of child and the data is made. Through the K-Nearest Neighbour classifier with K value 5 from ski- kit learn, weight class is predicted considering the age, gender, height, and weight of the child and according to the classified weight class protein requirement in grams is predicted. was chosen for the same. This prediction model is exported using the pickle library and deployed on the front-end.
3. Food ingredients and Gaining: Food ingredients which have proteins are stated by mid-day meal [11, 12]. According to that, the data of food ingredients like Food grains, Vegetables, Pulses, Oil & Fats are dependent for the gaining of a particular child. Analysis and prediction for the child's gain according to the food ingredient data is made considering all the necessary ingredients. Figure 4 shows the dataset.

IV. Result and Discussion

The food ingredients should also include MILK as an important part of the meal for children. Milk should be given according to the sections that are Primary and Upper Primary. The Quantitative importance of Milk in the meal is shown below. The colors specify what in the following pie-charts is mentioned below:

	Age_X	section	Foodgrains	Vegetables	Pulses	oil_fats	gain
0	4	Primary	95	45	17	4.5	0
1	5	Primary	96	47	18	4.5	0
2	6	Primary	99	50	19	4.8	0
3	7	Primary	100	52	21	5.3	1
4	8	Primary	103	55	23	5.7	1
5	9	Primary	110	57	24	6.0	1
6	10	Primary	125	60	25	6.2	1
7	11	Upper_Primary	140	65	28	6.8	0
8	12	Upper_Primary	145	70	30	6.5	0
9	13	Upper_Primary	150	75	31	7.5	1
10	14	Upper_Primary	155	78	34	7.8	1
11	15	Upper_Primary	158	80	36	8.0	1

Figure 4. Food ingredient data showing gain

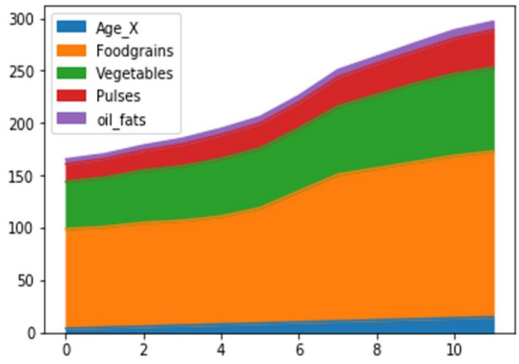

Figure 5. Area plot of food ingredient data

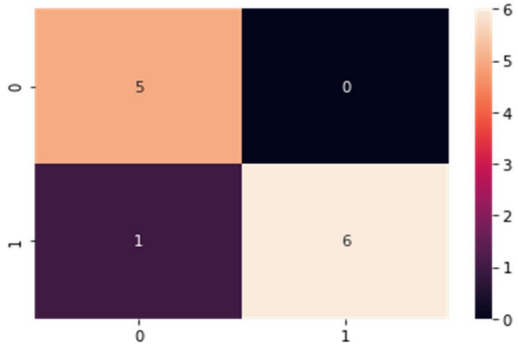

Figure 6. Heatmap of Confusion matrix of logistic regression model

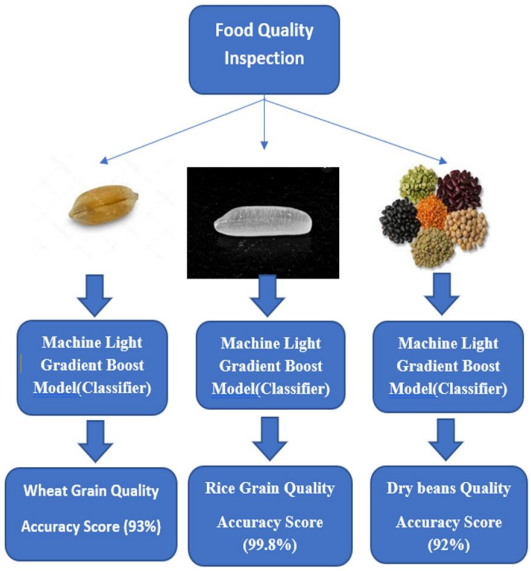

Figure 7. Workflow for inspection of food quality

1. Blue- Milk
2. Red- Food grains
3. Green- Vegetables
4. Violet- Pulses
5. Orange- Oil fats.

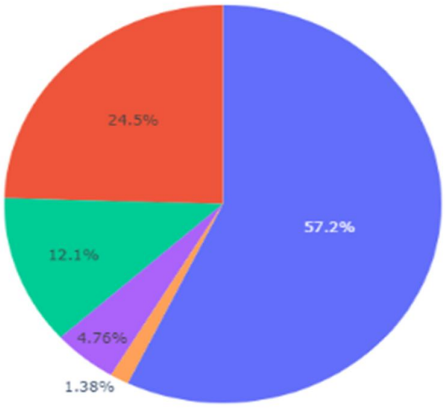

Figure 8. Pie chart of food ingredients including milk (Primary)

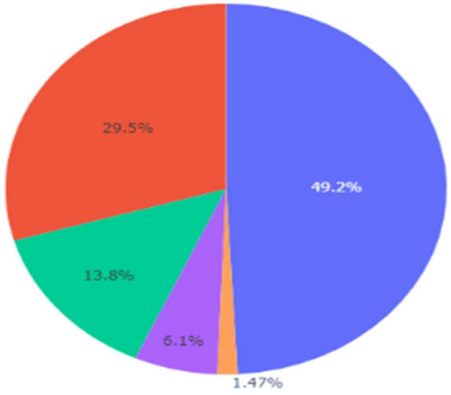

Figure 9. Pie chart of food ingredients including milk (Upper Primary)

TABLE I. RESULTS OF EACH MODEL

Model	Accuracy	Precision	Recall	F1-score
KNN Classifier	94.2%	0.93	0.94	0.945
Logistic Regression	91.6%	0.93	0.91	0.915
Rice quality (Light Gradient Boost (LGB))	99.88%	1.0	1.0	1.0
Wheat quality {LGB	92.52%	0.925	0.925	0.925
Dry beans quality (LGB)	93.22%	0.94	0.94	0.94

Figure 10. K-NN form for Protein purpose

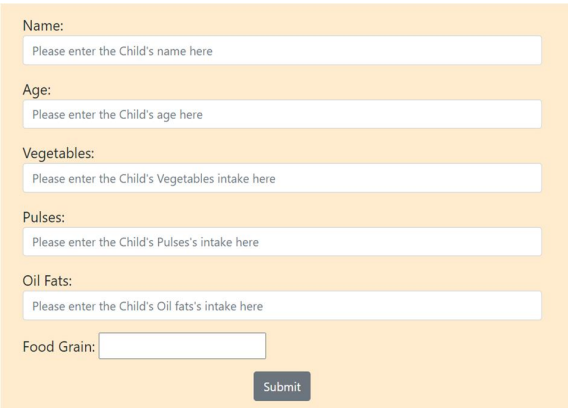

Figure 11. Logistic Regression form for gaining purpose

This is how the form for predicting the amount of protein for a child of age 'x' looks like. The Linear Regression model is integrated with this form for prediction purposes. This is how the form of predicting if a child is gaining from all the food intake they are getting looks like. The Logistic Regression model is integrated with this form for prediction purposes

As far as comparing this study with pre-existing models goes, there are no models up until now in which the analysis of the whole Mid-Day meal program is done. Be it the schools, or the meal served for each child, or be it inspecting the quality of rice provided by the central government.

V. Future Scope

In the future, the aim would be to do a state-to-state analysis of mid-day meals whether the state is funded well and is each school in every state individually, providing its students with the needed nutrients proportionally in a meal. Another aim could be analysing the meal plan of the mid-day meal scheme if eggs, milk are added as a protein source in the diet of students and to check how the addition will be beneficial for the children [13, 14].

VI. Conclusion

In India, the concept of a mid-day meal dates back roughly a century. To embark upon an ambitious scheme to improve the health of the younger generation of our country and completely eliminate starvation and malnutrition, our government started a Mid-Day meal program. The proposed model focuses on helping the public health planners to provide a proper, wholesome, and nutrient meal with a proportionate amount of food grains, pulses, oils, and fats. This study also checks the number of registered and non-registered schools in each state to see the number of children covered in each state, thereby the funds which are currently provided, and which states require more funding by the dataset we took from the official sites for reference. After analysing these parameters, the focus was on the nutrient values of the meals by finding out the minimum requirements of protein and other components necessary and how much the primary and pre-primary children are getting in their daily meal.

To inspect food quality that is being served to the children, in this study rice grain, wheat grain and dry beans datasets were considered, and a classifier model was implemented on the same.

Recently the officials of Mid-Day meal had put a word that milk will be added along with the regular meals to add on its benefits to younger children's diet daily. So, to conclude the study analysis of how adding milk will be an excellent way of increasing the meal's nutrient value.

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