Feedback-Based Real—Time Surveillance for MidDay Meal Scheme

Kartik Joshi and Shyam Vadalia

Abstract There is a growing demand of a proper supervision of the midday meal scheme that is enforced in India. Last decade statistics and news articles tend to suggest that there are many loopholes in the current system that needs immediate attention to help effective enforcement of the scheme at the grassroots level. Our proposed system provides a holistic approach towards supervision of the scheme. This system, when implemented in compliance with the Government regulations, can help the concerned authorities in monitoring the execution of the midday meal scheme eliminating the scope of error. Our proposed system is capable of performing real-time food detection, counting number of students through state-of-the-art surveillance cameras with machine learning capabilities. The application is trained on Indian food that can be deployed in Indian School. In case of discrepancy, the user can report discrepancy with a thorough follow-up mechanism that enables authorities to take quick action against the reported complaint. The proposed system enhances the current monitoring process. The system is robust to the changes in the menu. This helps in monitoring process supervised by the government authority. This standalone application can help the governing authorities to have an all-round inclusive approach and magnify the supervision process under a single platform.

Keywords Midday meal scheme · Image classification · Convolutional neural network · Video surveillance · Chatbot support

1 Introduction

Midday meal is a visionary scheme that initiates the fight to combat malnutrition among school going students. Students get free meals in the school premises. This

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has helped India keep a check on the malnutrition of children. Looking back at the journey from its inception, the scheme had its fair share of recognition and criticism. While there are lots of organizations such as Akshaya Patra, Anna Amrita Foundation are trying to provide exemplary service to schools, and there are some schools in parts of India which still find it difficult to effectively implement the scheme as per the government regulations. According to a study of nutritional health status of primary school children (7–9 years of age) in Bareilly district [10], it is found that the children belonging to the rural area are suffering more as compared to that of in the urban area. Also, a recent study on the impact of midday meal scheme on the nutritional status of rural middle school children (9–5 years of age) [12] shows that nutritional intake of children was lower than recommended dietary allowance of Indian Council of Medical Research (ICMR). According to that study, the midday meal food was low on calcium, iron and vitamin A (Fig. 1).

Unhygienic food and inadequate supply of food against the estimated demand are major issues faced. The unhygienic food simply compromises with the goal and principle of the scheme. And inadequate food prevents the scheme to scale up to appreciable level to eradicate malnutrition. These issues need to be addressed properly in order to make the scheme a success.

If we look at the scope of error causing these pitfalls, it is clear that there is a lot of potential for improvement. Unhygienic food could also result in food losing its nutritional value. Our proposed method uses third party Application program interface for detecting the food and obtaining the calorie count of the food from the image of the food. The food detection algorithm is trained on Indian food. This can

Fig. 1 School students having food under midday meal scheme

be matched with the nutritional chart provided by the government in compliance with the Food safety and standards authority of India. This can help in comparing the food prescribes against the meals that are actually delivered. The lapse can be evident from the camera infrastructure made available.

The lapse in valid information is yet another aspect that is contributing to the failure of the scheme. The regular count of the number of students is very important to maintain the availability of meals for all the students. The camera capabilities have improved over the course of time, and the deep learning boom has helped in tackling this issue. Installation of cameras can help keep a track of the students and help the authorities to make a sound decision on the stock of the food. The figures reported now are a result of mere manual observation which is prone to error. This loophole makes the scheme vulnerable to fail. We present a system to count the number of students availing the meal everyday using the camera and machine learning algorithms. This data could be then forwarded to the authorities, so that the gap between the demand and supply is reduced.

The surveillance system is also enabled with a feedback mechanism, backed by Chatbot support. Any discrepancy in the delivered meal, either qualitative or quantitative, can be reported to the authority through Chatbot. This approach makes the system fast and responsive to the needs at the grassroots level. This attempt makes the system flawless and accounts for the responsibility of the officials. This platform could also be used to address everything related to the scheme and communicate with the people.

2 Related Work

2.1 People Counting Applications

Counting number of people in the surrounding area has been interesting problem for study in the field of computer vision. Dittrich introduced the idea of array of cameras in people counting in crowded and outdoor scenes using a hybrid multi-camera approach [5]. This could be very useful in crowded places like schools. Another approach proposed by Deepak Babu Sam [4] was using modular paradigm, detecting head in the densely crowded surrounding.

But the hybrid multi-camera approach is not possible in the current scenario due to the poor camera infrastructure of the Indian government school. Their approach is unable to distinguish students availing the scheme from others. Drawing inspiration from their work, we intend to deploy the crowd counting system customized for school. Considering the characteristic feature of people availing midday meals, we extract the visual leads such as uniform, identity card to leverage the security aspect. Such system also helps in keeping a track of people on a regular basis. This is a crucial module in effective functioning of the surveillance system enabling the maintenance

of the meal count for availability of sufficient stock of meals. Shortage of meals is one major contributor of failure of the scheme and resulting in malnutrition.

2.2 Nutritional Value Supervision

In recent years, there has been increasing concern over obesity, and as a consequence, we see a surge in development of calorie counting systems. With more and more datasets related to the food images being generated, there has been advancement in the food detection and processing algorithms. Initial works have suggested for having nutritional fact tables populated corresponding to the food item. Pouladzadeh et al. [11] are based on this idea. There have been many third party applications offering the service of daily calorie count based on image upload by the user. ClarifAI [7], Calorie Mama are few of the products that we have for reference.

In [8], Chokr presents a three-phase pipeline at approaching to this problem. This is an improvement to the previous work as it involves a supervised method for arriving at the nutritional count of the food. Our implementation combines these techniques and banks on the application programming interface to get the calorific value of the food being offered at the school as a part of the midday meal scheme. The challenge to this approach is to customize it for the Indian food. This is tackled by training on several images of each of the meals and mapping it to the nutritional fact table of the same. This is very crucial for the system to perform well. This will help in verifying the nutritional value of the meals being served.

2.3 Feedback Mechanism Using Chatbot Support

In this day and age, availability is quite essential. All time availability of staff in government organizations could be a costly affair. So, Chatbot is finding its significance in these scenarios. The idea is to collect information. There have been several platforms and frameworks explored by Kar and Haldar in [13] that also reflected the commercial success of such platforms.

We explore a couple of such platforms Snatchbot [14] and Collect.chat [3] and compare their performances in case of deployment. Chatbot provides a robust solution to make the system all time available and introduces a feedback mechanism. We implement the design suggested by Adam et al. [9] in building a human centric conversational artificial intelligence agent that helps the user report discrepancy in the midday meal scheme, schedule an appointment with the concerned authorities.

3 Simulation

We present a single digital platform to solve the midday meal scheme management issues. The proposed system (1) identifies people in a densely populated hall, (2) counts the number of people, (3) computes the nutritional information of the meals being offered and (4) provides a feedback mechanism using Chatbot platform to make the system flawless.

Multiple cameras embedded in the school hall can help in recreating the exact scenario giving more accurate details. As proposed by [2], the system has multiple camera feeds. The cameras are responsible for tracking the number of people present in the hall and counting the number of calories present in the meals being offered. The website is maintained with the weekly report being generated. These can be monitored by the government officials, eliminating the scope of error. In case of any discrepancy related to the food or the services, the concerned authorities could be informed using Chatbot platform.

The overview of our proposed system is reflected in Fig. 2

3.1 People Tracking and Facial Recognition

We use the one shot detector for facial recognition which uses triplet loss function to compare positive, negative and anchor image. Results from [1] are encouraging to bank upon triplet loss as the optimizer. Facial features of individual students are unique and are mapped with the identity card. Following is the equation of the triplet loss function derived from FaceNet: [6]

$$\left\| f\left(x_i^a\right) - f\left(x_i^{p^p}\right) \right\|_2^2 + \alpha < \left\| f\left(x_i^a\right) - f\left(x_i^n\right) \right\|_2^2 \tag{1}$$

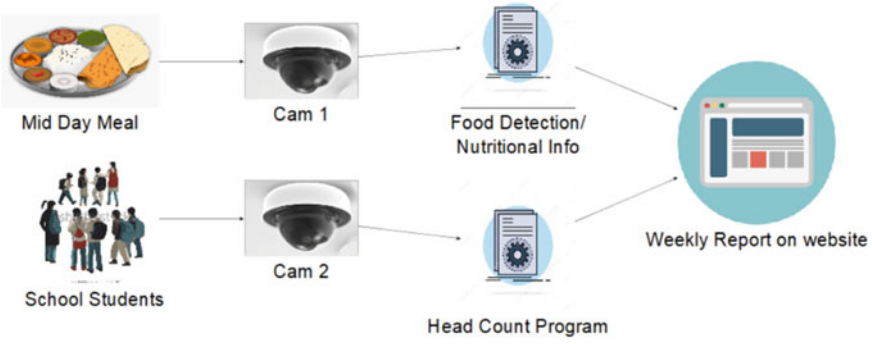

Fig. 2 Block diagram of our proposed system

Fig. 3 Photo of Indian bread

Another approach that could be helpful is the DocFace implementation presented in [15] and [16] which involves mapping of student's identity with their face. A combination of transfer learning and using a domain-specific dataset of ID-Selfie pairs helps in building a robust facial recognition module. This is very critical for sufficient supply of meals to the students registered for the scheme.

3.2 Nutritional Information using Food Images and Fact Tables

Recently, there has been a lot of work done on mapping the food images with the nutritional information. As a result, there have been several application programming interface for the same. With a combination of application programming interface and dataset of Indian food images, we perform the task of food detection and nutrition information extraction (Figs. 3 and 4).

3.3 Discrepancy Report Using Chatbot Support

Our system digitizes the process of midday meal supervision and drastically reduces the scope of error. We also consider the possibility of prospective error and provide means of rectifying it using all time available Chatbot. With the conversational agents getting more smart using the sheer scale of the corpus available and leveraging natural language processing techniques, producing near human results for conversations is not a difficult task and falls beyond the scope of our work. We, however, explore

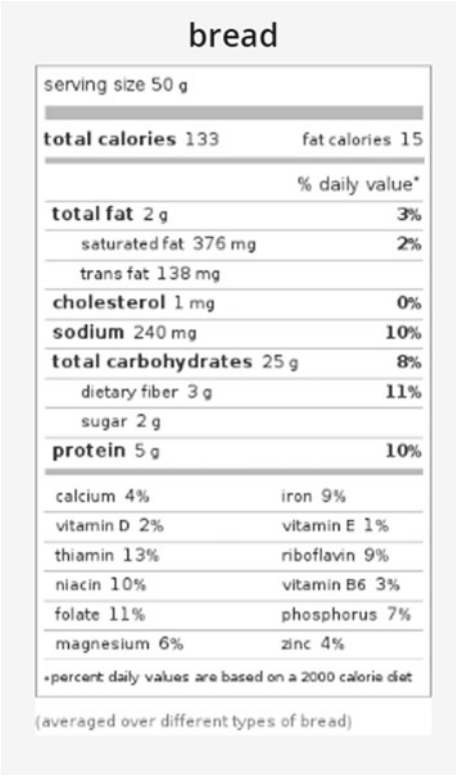

Fig. 4 Nutritional info of bread (roti) using food detection model

the digital platforms available for making a customized Chatbot, with capabilities to personalize the human interaction. This includes omnichannel support, scheduling appointments et al (Fig. 5).

4 Result

In this section, the results of simulation of all the features will be presented. Based on this, we draw our conclusion and provide insights towards building a robust system.

4.1 People Counting Using Facial Recognition

Using the vanilla FaceNet model for the facial recognition helped in establishing a baseline for the task at hand. Other approaches including [4] and [16] could be considered to enhance the model for accommodating Indian faces as the FaceNet

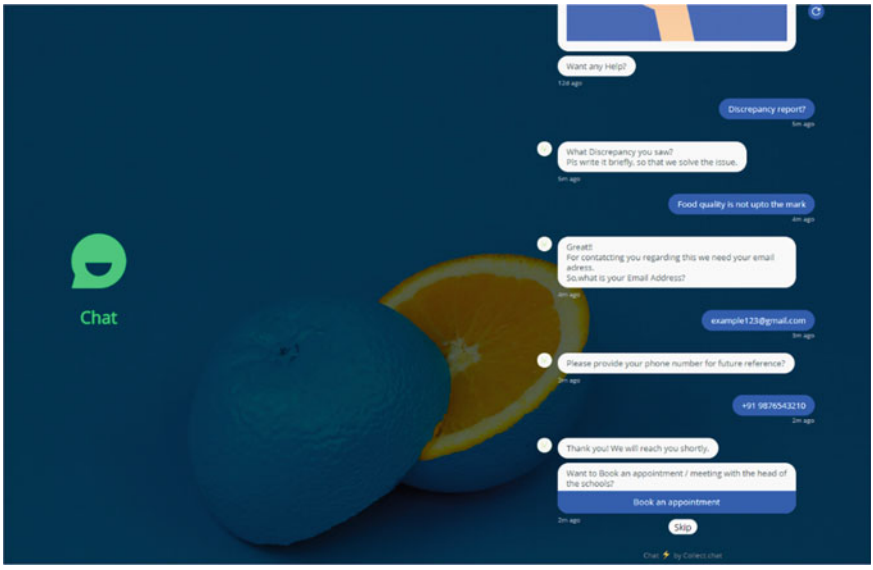

Fig. 5 Reporting a discrepancy using collect.chat

model has a potential bias towards Siamese faces. This also gives us insight about the future work towards Indian face recognition. With this idea in mind, we can integrate the database consisting of student's identity card and their photograph to come up with a solution similar to [16].

4.2 Food Detection/Nutritional Information

The goal of this feature was to identify the food items being served under the MDM scheme. We use off-the-shelf applications for the purpose of food detection and nutritional information extraction. Services offered by ClarifAI, Wolfram and Calorie Mama have shown exemplary results with their artificial intelligence techniques. We have used that model to train on custom Indian food images. The results obtained are shown in figure below are the result from using the clarifai's food model for extracting nutritional information from the image of rice provided as per the midday meal scheme menu (Fig. 6).

As an extension to the food detection and nutritional information, the velocity of the data could be accounted by regularly updating the menu as shown in Fig. 7.

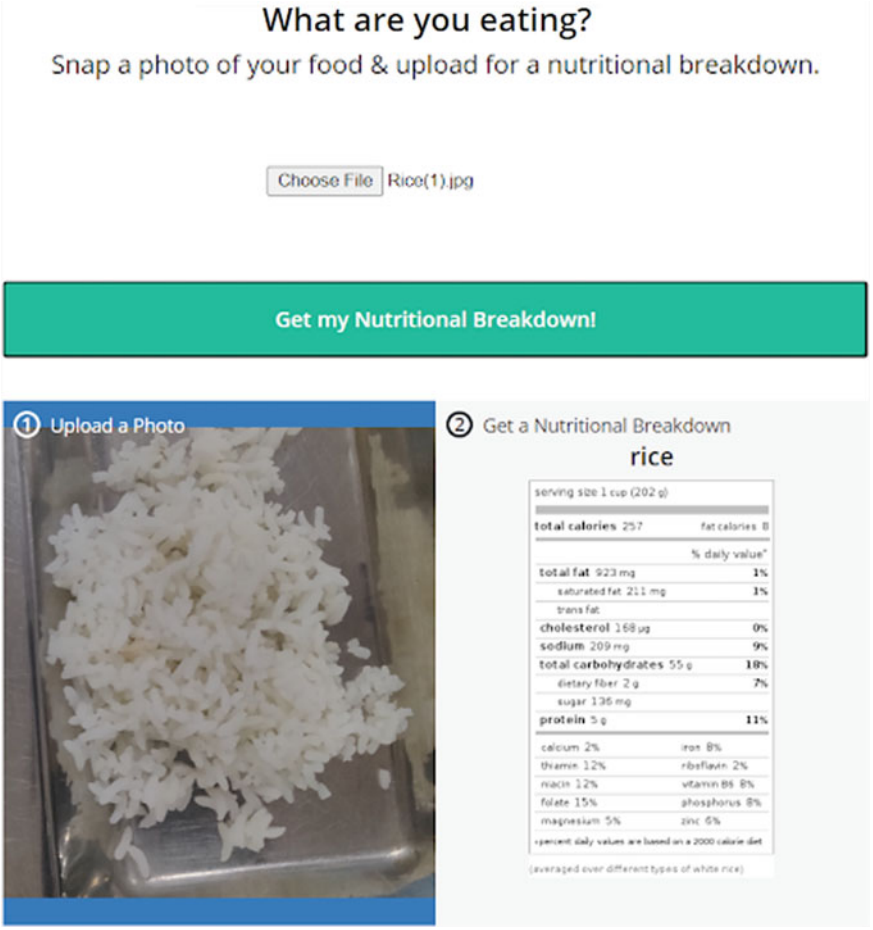

Fig. 6 Nutritional info of rice using food detection model

4.3 Discrepancy Report Using Chatbot

All time available Chatbot is achieved using the existing platforms that enable user to schedule a meeting with the concerned authority.

According to user reviews as collected by peer-to-peer review digital platform—g2.com, businesses have found collect.chat a better platform. Even though Snatchbot platform outperforms in terms of meeting requirements, but Collect.chat is found to be better in terms of ease of setup and ease of admin.

While Snatchbot is useful for large-scale enterprise, Collect.chat retains its popularity at the grassroots level with 80 percentage of small businesses against 26.7 percentage in case of Snatchbot. This clearly favours Collect.chat for the use case of midday meal scheme schools having 50 or fewer employees.

Fig. 7 Dynamic updation of weekly menu on website

Table 1 As reported by peer reviewers at g2.com, business software and services review

Collect. Chat	Snatchbot
Marketing and advising (30%)	Information technology and services (50%)
Internet (30%)	Retail (6.7%)
Printing (10%)	Supermarkets (3.3%)

Table 1 shows the reviewer industry distribution (Top 3) for the two platforms:

5 Discussion and Conclusion

With aim of improving the existing monitoring infrastructure, we provide our insights towards building a flawless system for midday meal surveillance and analytics. The existing monitoring procedure is manual and has a scope of error. We introduce techniques to automate the process in order to reduce the error. Our paper explains that by automating the monitoring task, there will be a significant reduction in error.

Despite the fund allocated for the scheme, it still fails at the execution phase. When it comes to ground level, there is a need of a feedback mechanism which is responsive to the demands and complaints of the authorities. The paper thus presents ways to curb the loopholes by implementing a transparent feedback approach to make sure that the concerned authorities are reported in a timely manner with mechanism to take a thorough follow up with them. In future, we plan to enhance the involved modules to cater to a larger audience with customized solutions.

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