Summary

Number of books and chapters in edited volumes/books published and papers published in national/ international conference proceedings per teacher during last five years

ISBN Number	Title	Author	Department/ School/ Division/ Centre/ Unit/ Cell	Name	Year of Publication
0973-2861	1.A STUDY ON FOOD RECOGNITION & NUTRITION ESTIMATION	Dipti Belsare	MCA	Journal of Analysis and Computation (JAC) www.ijaconline.com, Volume XVI, Issue IV, Jan-June 2022	2021-22
2229-5232	2.A REVIEW ON VARIOUS APPROACHES IN MACHINE TRANSLATION FOR SANSKRIT	Dr. S. D. Deshpande	MCA	International Conference on Computer Technology, Management and it's Application (IC2TMA-2020) Proceedings published in "MANTHAN 2020"	2019-20
2229-5232	3.REVIEW OF SMART GARBAGE MONITORING AND SOLID WASTE MANAGEMENT SYSTEM	Dr. Minakshi Tumsare, Dr. Ravikant Zirmite, Dr. S. D. Deshpande	MCA	International Conference on Computer Technology, Management and it's Application (IC2TMA-2020) Proceedings published in "MANTHAN 2020"	2019-20

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A STUDY ON FOOD RECOGNITION & NUTRITION ESTIMATION

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ABSTRACT

Nowadays, maintaining a balanced diet and avoiding obesity in the human body requires a regular & standardized intake of healthy food. This study uses computer vision via the use of a mobile phone and techniques of image processing and pattern recognition to identify food items in the picture and shows their nutritional values for dietary assessment. The amount of calories that the food contains is taken into consideration here based on that nutritional values are shown. Food image recognition is a difficult task due to the nature of the images, which is why existing approaches in image recognition have achieved low classification accuracy. Deep neural networks have overcome this problem and with help of this, we present an approach to the problem of food image detection, recognition, and nutrition estimation using convolutional neural network architecture.

Keywords - Deep learning, food image recognition, dietary assessment, nutrition-estimation, Machine Learning, Convolutional Neural Network

[1] INTRODUCTION

Recently, people are becoming used to modern lifestyles since they are busy with their schedules at work and home. Obesity in adults, as well as children, is becoming a common problem. The main cause of obesity is a combination of over food consumption and lack of physical activities. Currently, the research done shows that people who are obese are most likely to have serious health problems (hypertension, heart attack, diabetes, high cholesterol, cancers, and blood pressure). On the internet, consumers can find a wide range of nutritional information and standards at their fingertips. However, this information has not prevented diet-related issues or helped people to eat healthily. In most cases, people find it difficult to examine all of the information about nutrition and dietary plans. Moreover, people fail to care about measuring or controlling their daily food intake due to a lack of nutritional knowledge, irregular eating patterns, or lack of self-control. Providing people with an effective long-term solution requires mechanisms that help them make permanent changes to their calorie intake. A system

that monitors, records, and measures the number of calories consumed in a meal would be of great help not only to patients in the treatment of obesity but also to the average calorie-conscious person or fitness freak.

Our goal is to empower users with a convenient, intelligent, and accurate system that helps them become aware of their calorie intake and find the individual nutrient content in the food item. To identify the food in the system, image processing, computer vision, feature extraction, neural networks, and segmentation will be used. It will measure the volume and weight of each food item and find the number of nutrients it contains like protein, iron, carbohydrates in the food and classify them.

[2] LITERATURE REVIEW

Recently, there has been an increasing number of researchers conducting experiments and research toward the fields of food classification, leveraging machine learning/deep learning algorithms.

Image recognition and interpretation are examples of high-level processing. Statistical or deep learning approaches are frequently employed to classify the target based on the application of interest in this step. The study's findings indicate that image processing is necessary. K-nearest Neighbor (KNN), Support Vector Machine (SVM), neural network, fuzzy logic, and a genetic algorithm are examples of algorithms that can aid in the interpretation of visual data. In the food sector, neural networks and fuzzy logic methods have been successfully applied to Machine Vision Systems.

[1]. Aizawa proposed a Bayesian framework-based approach to facilitate incremental learning for both food detection and food-balance estimation. [2]. Bossard used Random Forest on the Food-101 test set achieving a classification accuracy of 50.67% by mining discriminative components. The random forest model is used for clustering the superpixels of the training dataset. Other advanced classification techniques were also applied in the work including Improved Fisher Vectors (IFV), Bag-of-Words Histogram (BOW), Randomized Clustering Forests (RCF), and Mid-Level Discriminative Superpixels (MLDS). [3]. B.Deepak proposed a system of Food recognition that can detect and recognize food items based on the input image. His model is trained on 101 categories of food items using CNN (Convolutional Neural Network).

[4]. Krizhevsky used GPUs to train the AlexNet, which enabled faster training of CNNs models. The network consists of 5 convolutional layers and 3 fully connected layers. [5]. Karen Simonyan and Andrew Zisserman proposed the VGG-16 model which achieved 92.7% top-5 test accuracy in ImageNet. The 16 in VGG16 refers to it has a total of 16 layers that have weights. [6] Introduced by Shaoqing Ren, Kaiming He, Jian Sun, and Xiangyu Zhang, the ResNet (Residual Network) model have a 34-layer plain network in the architecture that is inspired by VGG-19. [7]. DensetNet developed by Gao Huang, Zhuang Liu has n(n+1)/2 connections in total because of feed-forward fashion. [8]. Shuffle Net is an extremely efficient CNN architecture with 173 deep layers, designed for mobile devices with the computing power of 10–150 Mega FLoating-point Operations Per Seconds (MFLOPs).

Additionally, researchers started to investigate which features and models are more suitable for food recognition and computed them into a food analysis system to calculate the calories. Multi-task convolutional neural networks are used for simultaneous learning of food calories, categories, and ingredients to automatically estimate the food calories from a meal image.

Though food recognition and nutrition contents analysis have been well discussed by the above work, three basic challenges remain. Firstly, most of the approaches are dealing with recognizing the food item with the help of a single picture. Secondly, Dataset becomes much larger when it comes to food images, so currently, we will be taking a finite dataset for training. Thirdly, similar types of images that are the same in terms of size and shape are difficult to recognize.

In this paper, I aim to address these issues and propose a system that identifies food from images and calculates nutritional values by increasing and improving the accuracy of the system. I aim to develop and train it on various images acquired from web searches for individual food. With this, I will try to achieve a higher classification and accuracy than most of the results presented and found.

[3] IMPLEMENTATION

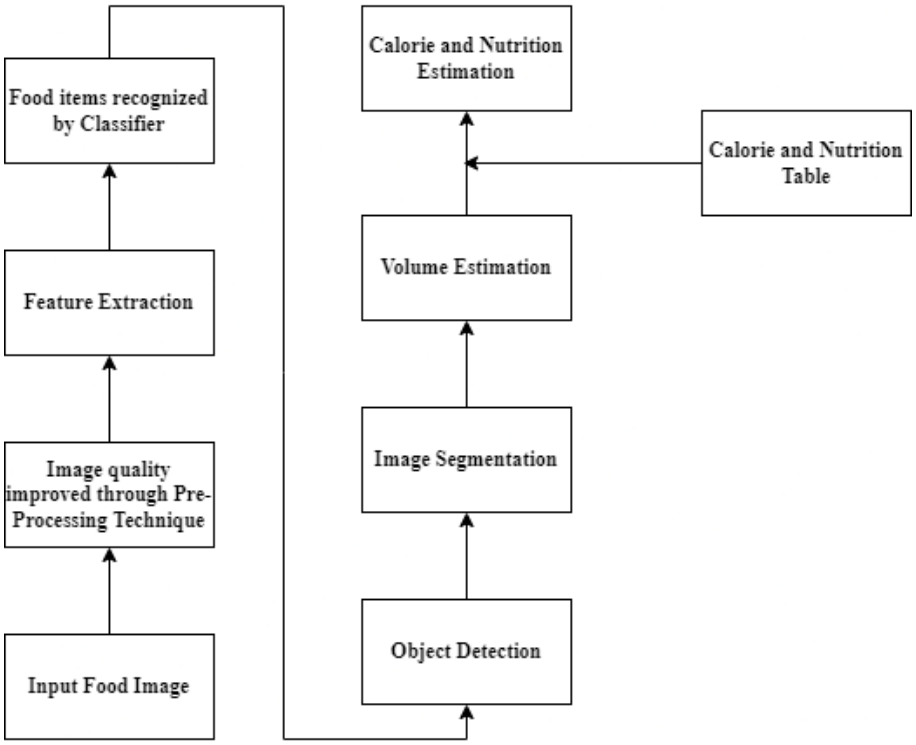

Fig.1

Steps to be followed are:

a. Pre-Processing - In Pre-processing, basically removing noise and normalizing the food image, if the image in any format needs to be converted in the specified format, resize in the specified size and remove unnecessary features from it. Pre-processing techniques include Histogram equalisation, filtering, and RGB picture to Grayscale conversion, among others.
b. Features Extraction - Feature Extraction is a crucial stage of the Face Recognition System (FRS) where the performance of recognition is dependent. It extracts the feature

vector, which is a meaningful set of data. Feature vector represents the properties of food.

c. Classification - Classification applies the feature vector on training and testing images. It is used for the result of the outcome in recognition. There are different classifiers like Support Vector Machine (SVM), Deep Learning Neural Network, Artificial Neural Network (ANN), and Convolutional Neural Network (CNN).
d. Object Detection - Calibration objects are detected by an object detection method called [9]. Faster R-CNN where we put an image with RGB channels as input and get a series of bounding boxes. For each bounding box created by Faster R-CNN, its class is judged.
e. Image Segmentation - After detection, we need to segment each bounding box. [10]. GrabCut is an image segmentation approach based on optimization by graph cuts. For each bounding box, we get a precise contour after applying the GrabCut algorithm. After segmentation, detecting the boundaries of irregular food portions becomes easier, and food portion detection improves. After that, we estimate each food's volume and calorie.
f. Volume Estimation - We need to calculate scale factors based on the calibration objects. For this, we can use 1 Yuan coin (basic monetary unit of the People's Republic of China) as a reference (diameter-2.50cm) and calculate the side view's scale factor, top view's scale factor and select the required volume estimation formula.
g. Calorie Estimation - After getting food volume, a food's calorie is calculated by searching its density in the food density table [11] and energy in the nutrition table.

[4] EXPERIMENTAL IMPLEMENTATION

Convolutional Neural Networks (CNN):

A deep learning neural network called a convolutional neural network (CNN) is a type of deep learning neural network. It's a machine learning method that takes an image as input, assigns significance to various aspects/objects in the image, and can distinguish between them. It works by extracting features from the images. CNN consists of the following:
1. The input layer is a grayscale image.
2. The Output layer which is a binary or multi-class labels
3. Hidden layers consist of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network.

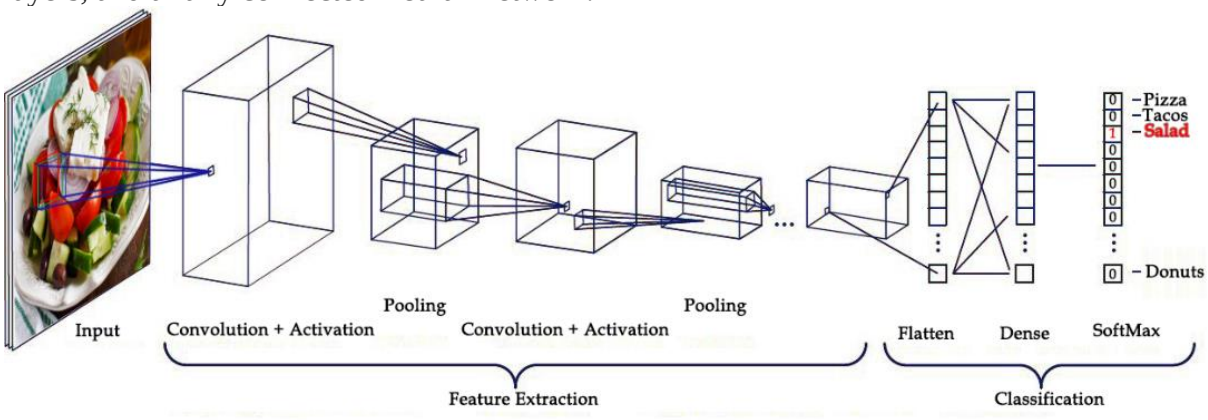

Fig.2 - Simple CNN Architecture [12]

TensorFlow & Keras:

In the past few years, various techniques have started to become available to the broader software development community. Industrial strength packages such as TensorFlow have given us the building blocks that Google uses to write deep learning applications for embedded/mobile devices to scalable clusters in the cloud without having to write code for GPU matrix operations, partial derivative gradients, and stochastic optimizers that make efficient applications possible. On top of all of this, there are user-friendly APIs such as Keras that abstract away some of the lower-level details and allow us to focus on rapidly prototyping a deep learning computation graph. We can mix and match to get the desired result. Keras and other Deep Learning libraries provide pre-trained models. There are deep neural networks with efficient architectures (like VGG, Inception, ResNet) that are already trained on datasets like ImageNet. Using these pre-trained models, we can already use the learned weights and add a few layers on top to finetune the model to our new data. This helps to save time and computation when compared to other models trained from scratch.

ReLU:

The rectified linear unit, or ReLU, is a method of increasing the non-linearity of a network without changing the receptive fields of convolution layers by using an activation function. ReLU enables faster data training, whereas Leaky ReLU can manage the problem of vanishing gradient. [13] Sigmoid function, Softmax function, Hyperbolic Tangent(tanh), Leaky Relu, Parameterized Relu, Exponential Linear Unit (ELU), Softplus, Softsign, Scaled Exponential Linear Unit (SELU), Linear Action function are some of the additional activation functions.

[5] DATA MANAGEMENT AND ANALYSIS METHODS:

Food Image Dataset:

For the experimental needs of the system, we will use a dataset named Food-101[14]. This dataset has 101000 images in total. It's a food dataset with 101 categories(multiclass). There are 750 training samples and 250 test samples for each food category. The training images were not cleaned on purpose, so there is still some noise in them. This comes mostly in the form of intense colours and sometimes wrong labels. All of the images were resized to a maximum of 512 pixels on each side. The entire dataset is 5GB in size.

Evaluation:

To evaluate the performance of the food recognition system, we visualize random images from each of the 101 classes and then split the image data into train and test using train.txt and test.txt. However, working on the entire data set with 101 classes takes a lot of time and processing to experiment and try other designs. To continue with my research, I'm going to make train min and test mini, which will limit the dataset to three classes.

Implementation:

The initial step is to import libraries like TensorFlow, NumPy, os, and pandas. Then, if you desire to adopt a GPU for training the deep learning model, please install CUDA with version

11.0 because that version holds TensorFlow with version 2.4.1. After that, we need to prepare data by producing a dataframe with columns and set parameters for the image augmentations technique. After we've created the batches, we can use the transfer learning technique to train the model because we don't need to build the CNN architecture from scratch. We will apply [15] VGG-16, ResNet50, Inceptionv3, EfficientNet architectures to our model. By using these 4 pre-trained models we will compare their results based on the accuracy of the test achieved.

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A Review on various approaches in Machine Translation for Sanskrit Language

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Abstract:

Machine Translation is an emerging field in computer science. It is one of the most significant applications of Natural Language Processing. Aim to focus on Sanskrit in Machine Translation is to come across the language suitability, its morphology and employ appropriate Machine Translation techniques. A review has been conducted on various approaches in Machine Translation in this paper. It begins with introduction to Natural Language Processing and its applications. Different types of ambiguities are discussed. Silent features of Sanskrit language are discussed. Then focuses on Sanskrit is used for Machine Translation and highlights the language features for Machine Translation. Different approaches of Machine Translation are given like Rule based, Statistical based, Direct etc. A survey of the work done on various machine translation systems either developed or under the development. General structure for Sanskrit Machine Translation system (SMTS) is discussed.

Keywords: Machine Translation, Natural Language Processing, Sanskrit, Morphology, Lexical

1. Introduction [2][4][6]

Machine Translation is very important application of Natural Language Processing; it removes the barrier so that humans can transform information, share ideas, know one another cultures, technological discussions etc. Machine translation helps to unite the world socially, culturally and technologically. There is big necessity for inter-language translation for transfer and sharing of information and ideas. Using machine translation one natural language can be translated to other. Natural Language Processing (NLP) involves making computers to perform useful tasks using languages used by humans.NLP have to face a lot of ambiguity during its processing and Sanskrit language overcomes all of these hurdles, because of "formally defined grammar", to become the best suited natural language for machine translation.

2. Natural Language Processing [6]

Natural language processing is the sub field of artificial intelligence dedicated to make computers understand statements or word written or spoken in human language. Natural language understanding at the input side and the natural language generation at the output side are the two major parts of natural language processing

2.1 Application of Natural Language Processing

Natural language processing provides a better human-computer interface that could artificial intelligence systems to pervade more efficiently into the present day applications like:

Translate one human language to another using translation program.

A program for grammatical errors checking in a given text.

A system for blind people with speech input.

The chair of Stephan hawking which converts text into speech.

3. Difficulties in Language Translation [7]

Due to different types of ambiguities Machine translation is a difficult task. For translation, ambiguity needs to be resolved. These difficulties are inbuilt in English but are not fundamental to all natural languages. Scientific Sanskrit is particularly specific i.e. clear and accurate. There are different types of ambiguities which depending upon study meaning of word, problem solving, explanation or understanding and number of meaning of one word etc:

Language translation in structural form- In this, words in a sentence is interpreted after the sentence combined into groups of words, which are without definite verb.

Difficulty or ambiguity in problem solving in specific way- This is related to context of sentence.

Lexical difficulty or ambiguity- when a single word has many different meanings and in this all meanings are potentially valid.

Difficulty in meaning of words or semantic ambiguity- This is related to sentence

4. Silent Features of Sanskrit Language [4][7]

India is multilingual country with as many as 22 scheduled languages of which Sanskrit is one among them and it's official language of state of Uttarakhand, India. It is considered as the oldest Indo-European language. It is holy and philosophical language in Hinduism, Buddhism, and Jainism. The Sanskrit is mother of most Indian languages. Vedas, Extensive epic, Upanishads, philosophical, mathematical, scientific, dramatic, poetic texts include in Sanskrit work. Grammar of Sanskrit is well organized and ambiguity less compared to other natural languages. Sanskrit grammar is given by Panini as "Astadhyayi". Feature of generating new words is most The most distinctive feature of Sanskrit language is feature of generating new words . 14 sets are given by Panini in Sanskrit language are called "Maheshwara Sutras", which explain Sanskrit in mathematical representation or form. Fibonacci series correlated with mathematical expression of language which explains every natural problem. Fibonacci

series is so simple and nature follows it because it generates the patterns. And this theory explained in Sanskrit as regenerative for computation. Context developing is based on language's grammar. Sanskrit language is a set of 14 rules given by Panini. These rules are used to form all sentences in Sanskrit. All these are possible only through object oriented approaches which is available in Sanskrit grammar.

Following are some salient features of Sanskrit language-

Sanskrits language is promoted as the language of processing for its relatively *unambiguous naturean* and *well laid-out grammatical structure.*

Sanskrit has a more *strictly defined syntax*, so it is technically more computable.

Sanskrit is the most *Scientific and Structured* language. There are many hidden algorithms in Sanskrit as a part of its vast scientific treatises, to analyze "Meanings" or "Word sense" from many perspectives.

The *word representation* in Sanskrit is done *by its property,* not according to the objects. Any object or a thing is named by the property it possesses.

All Sanskrit *words* are made of *characters*, either *vowels or consonants*. Vowels exist independently, while consonants depend on vowels. The process of *Sandhi* is defined.

Sanskrit *words are composed of two parts*, a fixed base part and a variable affix part, both forming an integral unit. The meaning of the word base, depending on a set of given relationships is modified by the variable part.

Sanskrit is a very *predictable language*. It is easy to formulate sentences and obtain meanings from words. It is easy to make words plural. So that a computer can inherently formulate sentences very easily.

Words are of either *nominal type or verbal type* i.e. denoting either entities or actions.

Sanskrit is clearly *differentiate between dual and plural case* and thus we can get an error free NLP.

Vibhaktis (cases) provides an efficient way of *segmenting* the sentences into *logical constructs* for natural language processing (NLP). The splitting of the sentences in Sanskrit is very similar to the semantic net models used for artificial intelligence systems.

Sentence formation in Sanskrit is done with the help of two well known tools *Vibhakti and Karaka.* Vibhakti assists for making sentence in Sanskrit, there are seven kinds of vibhakti which also provide information on respective karaka. Karaka approach guides for generating grammatical relationship of nouns and pronouns for other words in a sentence.

Sanskrit has *inflection based syntax* which makes the overall meaning of a sentence independent on the position of its constituent words. An inflection of a word means a different form of that word and is used for enhancing the meaning of the original word.

5. Sanskrit And Machine Translation [4] [5]

Sanskrit has formal defined grammar. For any language to become computationally doable, it should have following features

Less or Unambiguous Grammar

Guard against Mispronunciation/ Misspelling Resulting in Misconception

Total precision

Co-relation between written and Spoken form of words

Potential Grammatical Tools

Sanskrit language can be treated as best suited natural language for machine translation as it holds most of these features. The linguistic aspects of Sanskrit language that need to be considered while dealing with complexity in machine translation are as follows-

Phonetics and Phonology—knowledge about linguistic sounds - In Sanskrit it is known as Panini Shiksha shastra which connects to the Grammar and the rules of the grammar also abide by the rules of the Phonetics.

Morphology—knowledge of the meaningful components of words from stems and their generation and utilization - In Sanskrit this is called as 'pada vyutpatti'. In addition the methods for generating words are also explained step-by-step in Panini's Ashtadyayi like a mathematical equation.

Lexical—knowledge of meanings and equivalent words. Every Sanskrit lexical item has a one-one correspondence. So a particular word used in different places is the same from a semantics point of view.

Syntax—knowledge of the structural relationships between words - declensions of nominal forms /stems - In Sanskrit Vibhakti play this role – it has very tight rule thus there is no ambiguity.

Semantics—the meanings of words in a sentence related knowledge. Sanskrit has many ways of sentence meanings and their analysis on a scientific basis.

Pragmatics— knowledge of the relationship of meaning with respect to the context - this is the most complex as meanings change, based on context and many other factors. For pragmastics a wonderful Vyakarana treatise available in Sanskrit called as "Vakyapadiyam" by Maharishi Bhartrhari.

5.1Comparative View of English and Sanskrit [8]

English and Sanskrit comparitative view on

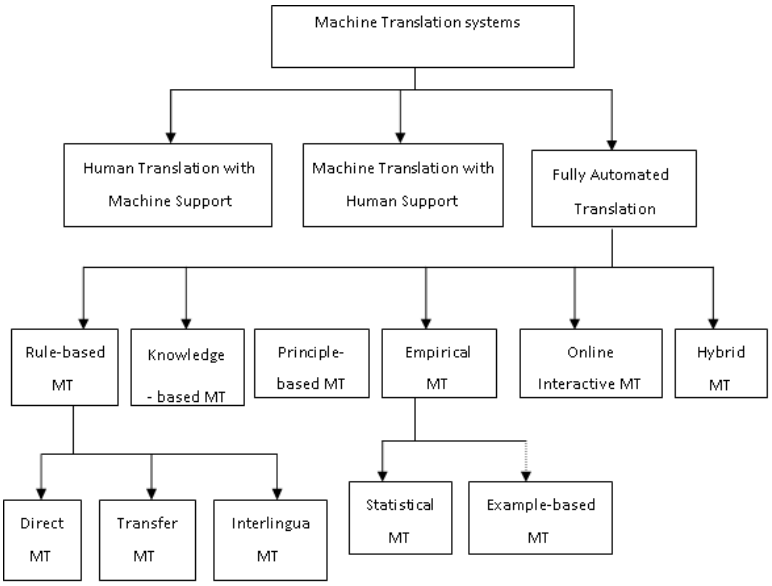
different basis as below :

Basis	English	Sanskrit
Alphabet	26 character	42 character
Number of vowel	Five vowels	Nine vowels
Number of consonant	Twenty one consonant	Thirty three consonant

Number	Two: singular and plural	Three: singular, dual and plural
Sentence Order	SVO (Subject-Verb-Object)	Free word order
Tenses	Three: present, past and future	Six: present, aorist, imperfect, perfect. 1st future and 2nd future
Verb Mood	Five: indicative, imperative, interrogative, conditional and subjunctive	Four: imperative, potential, benedictive and conditional

6. Machine Translation Approaches [2][3]

Machine Translation is classified into seven broad categories: rule-based, statistical-based, hybrid-based, example-based, knowledge-based, principle-based, and online interactive based methods. First three Machine Translation approaches are the most widely used and earliest methods.



7. Sanskrit Machine Translation Systems [1][2]

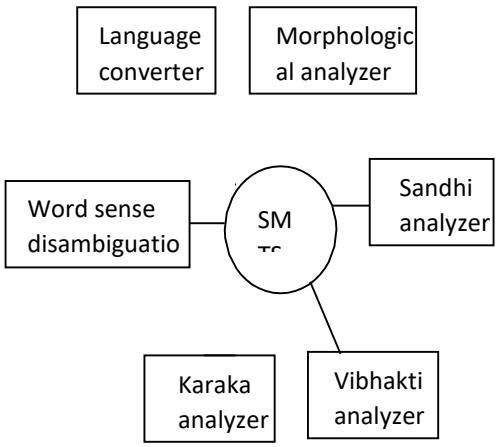
Comparison between some Machine Translation System either developed or under development.

Machine Translation System	Approach	Source-Target Language Pair	Features

DESIKA	Rule based	Sanskrit to Sanskrit	Desika is a Paninin grammar based system which includes Vedic processing and shabda- bodha as well
ANGLABHARTI	pseudo-interlingua approach.	English to any Indian Language	English is analyzed only once and creates an intermediate structure called PLIL. Further PLIL is converted to each Indian language through a process of text-generation..
GOOGLE TRANS-LATOR	statistical machine translation approach.	English to Hindi/Urdu/Snaskrit	Translation is provided only for Hindi, Urdu and Sanskrit.
ETSTS	Rule and Example based	English to Sanskrit	Using Bilingual dictionary and Modular design for converting target sentence to speech output
ESSS	Rule based	English to Sanskrit	English Speech to Sanskrit speech is converted via English and Sanskrit words
E-tranS	Rule based	English to Sanskrit	Synchronous Context Free Grammar (SCFG) is formed and used for language representation of syntax, Lexicon used for Morphological analysis
Sanskrit to English Translator by Subramania m A.	Rule based	Sanskrit to English	Focus on *Sandhi Vichheda* ,Morphological Analysis.
English to Sanskrit MT by Mishra and Mishra	Example based	English to Sanskrit	POS tagger Module, Uses ANN for verb selection, GNP Module.
English to Sanskrit MT by Warhade S, et al	Statistical based	English to Sanskrit	Phrase based
English to Sanskrit MT by Mane D.T. , et al	Rule based	English to Sanskrit	Use of bilingual dictionary and grammar rules file.

8. Components of Sanskrit Translational System [4]

Developing a Sanskrit Machine Translation System (SMTS) is much more fascinating and challenging task. MT is difficult because words can have several meanings. It is possible only by replacing the words in text by their equivalent words. Then modifying and arranging these words according to grammar. The components of proposed Sanskrit Machine Translation system (SMTS) include the modules as shown in figure



7. Conclusion

Sanskrit language has specific, unambiguous nature and vast literature and vocabulary, which prompt to be used as source language in machine translation. Machine Translation is a difficult task because words can have several meanings. Sanskrit is used as source or target language for development of Machine Translation systems. Still some systems are particular to specific domain, restricted to short sentences and phrases. Sanskrit language becomes challenging in Machine Translation application using Corpus based Machine Translation techniques due to its rich morphological nature. Systems using different translation techniques, suitable for particular domain are available for converting English to Sanskrit language. Additionally, we tried to describe briefly the different existing approaches that have been used to develop Machine Translation systems and proposed a general structure of SMTS which tried to utilize the salient grammatical features of Sanskrit language.

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A Review of Smart Garbage Monitoring and Solid Waste Management System

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Abstract:

In current scenario, the cleanliness of public places as well as private places are very necessary to make the environment healthy by spreading some deadly diseases, to avoid such situation smart garbage collection bins or Dust bin monitoring system is required. The collection of solid waste is also a need of common people as increased population growth. The workers who have to collect the garbage from different areas are not able to get correct information when would be the bins are filled. Sometimes it gets overflowed due to improper information, so they used to fix some timing for collecting the wastage or garbage. To overcome such kind of situations efficient garbage monitoring and cleanliness tracker system need to develop to make an effort to manage the waste and each has its advantages and disadvantages. This paper gives a brief literature review and observes previous research on different topics which includes different efficient techniques that can be used to manage the waste efficiently.

Keywords: Garbage monitoring, Cleanliness, Tracker system

INTRODUCTION

Over population in world it leads to increase in waste. People's faces major environmental challenges associated with reduced waste collection, transport and disposal. Hence garbage management is becoming a major problem. Compared to village more wastes are generated in cities and due to this the environment gets polluted and public health is also affected. All the above problems are solved can be solved by implementing the smart garbage collector dust bins and cleanliness tracker system. If in the public places the wastage are there then the corporation workers will get the alert to clean the particular area. So it will be helpful for them to identify whether the dustbins are fully filled or not. With the help of garbage monitoring and tracker system workers can collect the garbage time to time to make the environment healthy. Old system need more man power for waste management; by this system we can reduce the man power with the help of tracking system is interfaced with IOT.

REVIEW OF LITERATURE

In the view of last Ten years (2010-2020) research studies conducted so far on Smart Garbage Monitoring and Cleanliness tracker System.

SR. NO.	AUTHOR	YEAR	TITLE	AREA/ COUNTRY	OBJECTIVE	FINDINGS
1	Mihai T. Lazarescu	2013	Design of a WSN Platform for Long-Term Environmental Monitoring for IoT Applications		This paper presents the functional design and implementation of a complete WSN platform that can be used for a range of long-term environmental monitoring IoT applications.	The researcher addresses all phases of the practical development from scratch of a full custom WSN platform and they guided the specification, optimization and development of WSN platforms for other IoT application domains.
2	Insung Hong, Sunghoi Park	2014	IoT-Based Smart Garbage System for Efficient Food Waste Management	Korea	In this paper, an IoT-based smart garbage system (SGS) is proposed to reduce the amount of food waste. In an SGS, battery-based smart garbage bins (SGBs) exchange information with each other using wireless mesh networks, and a router and server collect and analyze the information for service provisioning.	The researcher implemented the system in Gangnam district for a one-year period as a pilot project and verified the results. The researcher found the adaptive user-oriented charge policy resulted in a reduction of food waste of about 33%, and it is expected that the system will thereby improve the efficiency of

						food waste management.
3	Dr.N.Sathish Kumar	2016	IOT Based Smart Garbage alert system using Arduino UNO	India	The main theme of work is to develop a smart intelligent garbage alert system for a proper garbage management. The paper also focused on the use of the ultrasonic sensor which is interfaced with arduino UNO to check the level of garbage filled in the dustbin and sends the alert to the municipal web server once if garbage is filled	The researcher has developed an embedded based intelligent alert system. This devised for the proper monitoring and maintenance of the garbage also gives the prevents the irregular cleaning of the dustbins by sending alerts to the concerned individual at regular intervals.
4	Arko Djajadi	2016	Ambient Environmental Quality Monitoring Using IoT Sensor Network	Indonesia	This paper is focused on a small step toward this global issue to help acquiring factual ambient environmental parameters. They provide the solution is in the form of an Internet of Things (IoT) module that can be easily organized in the desired geographical area	The researcher found that the module works well for both indoor and outdoor environment. Coverage area of sensors might be reason why sensors have bigger standard deviation. Temperature and humidity sensor and alcohol sensor give stable result both indoor and outdoor and the

						result is stable based on its standard deviation and systematic error
5	Vincenzo Catania, Daniela Ventura	2016	An Approch for Monitoring and Smart Planning of Urban Solid Waste Management Using Smart-M3 Platform	Italy	The use of Biometric cryptosystem scheme namely fuzzy vault and fuzzy commitment is used to defend the pattern which is extracted from the Multimodal biometrics and Two-Tier Security	The result shows that a mechanism for collecting "green points" was introduced for encouraging citizens to recycle.
6	Mokshada V. Patil	2017	A Review on Internet of Things Based Garbage Bins Detection Systems	India	The main goal of this paper is to work on environmental issues due to improper waste disposal and solve them for better health and hygiene of the people.	The results of the study integrates different sensing and communication technologies to monitor real time bin information that can enrich the efficiency of solid waste collection and ensure the timely removal of waste resulting in green and pleasant environment using IoT.
7	Somu Satyamanikanta and	2017	Smart Garbage Monitoring System	India	This paper proposing new garbage collecting way to	The researcher concludes that by using smart garbage

	M.Narayanan		Using Sensors With Rfid Over Internet Of Things		dispose the waste by using the latest technology like some sensors are connecting a some sensors to the bin	monitoring system using RFID over IOT's they can easily dispose the waste present in the garbage bins as early as possible without it affecting to the people and keep the surroundings clean.
8	Pallavi Chaudhari	2017	Comparative analysis of Garbage Management and Tracking System using IOT	India	The paper comparing three proposed garbage systems which are IOT Based Intelligent Bin for smart cities, Smart Garbage Collection Bin Overflows Indicator using Internet of Things, IOT based smart garbage alert system using arduino UNO	The researcher found that each bin should assigned with a unique id and consist of some amount of garbage. The hardware which is the electronic device (ie.Node MCU) is already connected to the dustbin, later each time the garbage is added to the bins the sensors identify the level and if the bin is 80% full, the unique id of the bin is transmitted to the controller.
9	Nirde and Muley,	2017	IoT Based Solid Waste Management System for Smart City,	India	Researcher focused on to enhance the practicality of IOT based Wireless Smart Wastage	Researcher develops the practicality of internet of things based solid waste management

					Management system	and collection system for smart city.
10	Trushali Vasagade,	2017	Dynamic Solid Waste Collection and Management System Based On Sensors, Elevator and GSM	India	The study describes the concept to implement and provides optimum solution for the major issue of managing solid waste properly in terms of collecting it and cleaning waste thrown outside the dustbin.	The result analysis of system proposed can be given in two forms: A. Accuracy of system in terms of cleaning garbage present outside the system B. Real time alert message sending based on sensor data.
11	Sharaaf N. A. Hijaz A	2017	Easy Clean – A Smart Solution for Garbage Finding and Collecting	Shri Lanka	This paper focused on the use of various sensors such as load cell sensors, ultrasonic sensors and Global Positioning System (GPS) module to track location and status of bins, GSM/GPRS shield for data transmission and arduino MEGA 2560 to interface the hardware units	Author provides the comprehensive solutions to the people that the system could read and transmit current status of the bin to the server. And also send required information of solid waste management using a centralized system. They are Developing the mobile applications to assisted driver with the collection.
12	T.G.Dhaara ni,	2018	Automated self-	India	The paper is highlighted; the	The researcher has developed

	G.Ramya Shree		navigating smart dustbin using IOT		level, rain and gas sensors are used to detect the respective parameters and garbage level is monitored by using IoT system and take necessary steps. Also focused on automatically opens the lid when it detects the people who want to throw out their trash.	an efficient waste management system and IOT based technology is used to provide better garbage disposal methods in urban areas. They used sensors to indicate the level of garbage in the bin.
13	Dr. P. Premkuram , P. Jeeva	2018	Smart Garbage System Using Internet of Things	India	The paper focused on the use of ultrasonic sensor and infrared sensor for automatic open closing of lid also with level detection, which became a hygienic and healthier way to use trash.	The results summarized the adaptive user-oriented charge policy is used to motivate residents to reduce their waste, and Web-based services are provided to achieve more efficiency in the disposal and collection processes.
14	Dr. Jittendranath Mungara, Shobha	2018	Survey on Smart Garbage Monitoring System Using Internet of Things (IOT)	India	The paper throws light on survey on few of the techniques and methodologies to improve the garbage monitoring system using wireless sensors.	They found that multi-layer waste management system architecture for design of a RFID; Using WIWSBIS, waste management service providers have a

						chance to track a waste identity, weight, missing/stolen bins quickly and accurately without human intervention.
15	Abdullah Alfarrarjeh	2018	Image Classification to Determine the Level of Street Cleanliness: A Case Study	USA	This paper propose a geo-spatial classification approach to enhance the classification accuracy, also presents a case study of street cleanliness classification using a large real-world geo-tagged image dataset obtained from Los Angeles Sanitation Department (LASAN).	The results found that due to the visual differences in street scenes across geographical regions, researcher proposed a classification scheme with multiple local trained models utilizing the geospatial characteristics associated with the images. The best variant of their approach achieved an F1 score of 0.9
16	S.Loganayagi, C.Jeyabharathi	2019	Development of an IOT System for Efficient Classification and Management of Solid Waste in Indian Cities- A Research	India	The researcher has made detailed survey on solid management system based on Internet of Things is proposed which permits the municipal corporations to supervise the dustbin status over web server	The researcher develops the internet of things practicality based on the management and collection of solid waste for smart city. He also designed automatic sensing system i using load cell and ultrasonic

					remotely and maintain the cities clean by optimizing time and cost needed for it	sensor to provide an automatic and efficient status of dustbin monitoring system
17	M.Vishnu Monishan	2019	Implementation of Novel Optimal Scheduling and Routing Algorithm on IoT-Based Garbage Disposal System	India	The researcher proposes a novel IoT-based system for garbage collection and disposal which integrates house hold bins (HHB) and mobile garbage collector (MGC) which have mobility for automatic garbage collection and disposal	The result indicates the integration of HHB's and MGC's for automating the collection and disposal of house-hold wastes. The author was experimentally evaluated the novel algorithm on trial-run under test-bed environment.
18	Swarna M, K J Anoop	2019	Iot Based Garbage Box Monitoring System	India	This paper focuses on a comprehensive and detailed investigation of waste management models execution of smart procedure as a key enabling technology in contemporary trash management system.	Researcher concluded that the system is so much helpful for monitoring the bins effectively without Over flowing onto the streets
19	Sonali Joshi	2019	Smart Dustbin using GPS Tracking	India	This paper throws light on developed three subsystems: smart waste bin	Study indicates that the hardware detects the level of garbage and

					and real-time monitoring system that are interconnected to perform as an efficient waste management system that yields to a green and healthy living environment.	the application sends the notification of garbage retrieval, it saves effort of garbage collectors by saving their time and cost of fuel of the vehicle.
20	B.Rajapandian, K.Madhanamohan	2019	Smart Dustbin	India	The paper focused on to find a solution by using a Smart Dustbin which is GSM and GPS enabled. They used an 'Ultrasonic Sensor' and a 'Gas sensor' to prevent overflow of dustbin as well as sense of bad odour and ensures timely disposal of the unhygienic contents of the Dustbin	The analysis of results is the usage of advanced Controller in the form of arduino along with GSM and GPS enabled system enhances the effectiveness of the overall solid waste segregation, collection and disposal system.
21	R. Sureshkumar, S.U.Prabha,	2019	Smart Garbage Management System Using Gps and Gsm	India	The paper is used to detect the level of bins automatically and the send data to the cloud and display it using user interface. Ultrasonic sensor is gives data based on the bins level in the garbage. arduino is used to process	The result identifies automation and embedded system to waste collection and provides a practical solution to help waste management system.

					the data from it and the NODE MCU is used to send the data to the cloud by interfacing arduino with NODE MCU	

1.2 Objectives

The paper primarily aims to present the study of existing cleanliness techniques and improvements in garbage collection to make it more efficient and effective by providing the real time status of the garbage bins.

To get the real time data of the garbage bin and sending the status to centralize system.

To improve the efficiency of the existing garbage collection system.

To achieve the benefits of the timely cleaning of garbage bins and saving of the fuel of garbage collection vehicle.

1.3 Conclusion

Authors has studied the number of literatures / Research reviews currently carried out by stated references to get an idea about the research done in various areas of smart garbage monitoring and cleanliness tracker system. The objective of this study was to improve the efficiency of garbage collection system by providing them real time information of the status of garbage collection bins which enables them to take action on the garbage bins located in specific area. In this way time can be managed and solid waste can be monitored effectively hence it is helpful for monitoring the bins effectively without over flowing into the specific areas.

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