Time Series for Managing Food Waste Using Machine Learning

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ABSTRACT-— In this financial period, lots of foods is getting wasted in food courts and in other source, especially from the different causes. According to the UN World Food Programme and other agriculture organization reports, one third of the foods are getting wasted daily, accounting for 1.3 billion tons of waste. Whereas the food shortage is one of the world's biggest problem. A survey that explains the wastage of food from hostels of IITB per year is 16,000 kg. This proposed system is to reduce and manage food waste using machine learning concepts. Load cell can be used to measure the weight of the waste food. Waste food measurement data can be fetched and transmitted to server. Transmitted data can be stored in database and further used to trainee the data set to predict the accuracy rate using Random forest algorithm. Through that, a comparison of the previous data and current data are taken in to account. From these data's, we conclude the accuracy rate which helps to reduce the food waste on production side on further days. Finally, we can reduce the food waste in public or hostel messes by proposing our method in their system regulations and also bring awareness among the people. Thus, an efficient way of utilizing the food and avoiding the wastage of foods is done.

KEYWORD—Machine Learning, Food waste, Random forest, IOT, time series

I. INTRODUCTION

For those that operate in food service facilities, the operational food waste management [1] faces a daunting challenge. Public and enormous number of private organization is keeping on working to find a perfect solution to solve this problem [2]. Technology gets evolving and internet of things (IOT) plays great role to improve the economic growth. As more and more data are generated and these data must be transported through the cloud [4], after the data is processed and resourcefully analyzed by objects and entities introduced to the Internet of Things[6]. In this article, we have built a test rig for the weights of food waste using IOT components. The data collected can be sent to a local server and processed (XAMPP). We suggest a machine learning algorithm [5] to train the dataset in order to produce comparisons on reports in order to quantify food waste based on that data. We should infer and control food waste on the supply side before it is served to the plates based on the study of real-time food waste [7]. It provides a clear insight into the accuracy rate of waste food to the supply side, allowing them to handle food wastes more effectively by means of using machine learning concepts [8] to trainee the dataset to generate comparison on reports to analyze the food waste. Through that analysis from real time wastage of food we can conclude and to reduce the food on production side before it serves to the plates. It delivers a detailed insight on production side to manage food wastes and it reduces the food waste on various public places [9].

II. LITERATURESURVEY

Since food recycling is a difficult challenge, we will concentrate our efforts in this paper on a food wastage measuring scheme [2] in the workplace, which delivers real-time data on food waste to employees through a computer-based dashboard. This study is primarily concerned with the incorporation of the various locations found in the workplace. In this model, higher management and employers will get a clear understanding of real-time food wastage data results by analyzing and generating comparative reports. This can be accomplished in one of two ways: manually (or) automatically (using the Internet of Things (IOT) as the underlying architecture) [10]. Existing system were smart dustbin and smart conveyor to isolate and remove waste from public places using concepts of Cloud networking and Internet of Things (IOT).

The absence of appropriate waste management has caused considerable financial and environmental problems. In order to reduce food waste, this paper introduces a smart garbage system (SGS) based on the Internet of Things (IOT). Wired mesh networks in an SGS allow intelligent battery waste containers (SGBs) to exchange information, which is collected and analyzed by a router and server for service provisioning [11]. A approach is suggested that combines inventory estimation and forecasting with smart dustbins, which evaluate waste thrown into bins using state-of-the-art object tracking techniques to provide insights into how to maximize the use of raw materials used in food preparation and further redistribution and valorization of unexpected waste. As a result, food waste is kept to a minimum. Smart dustbin was using strain gauge weight the waste food, through that we can remove waste once it filled [12]. Smart conveyor uses camera to capture the pictures of food to clustering the waste food items. Based on that captured images, the food can be isolate from the conveyor moved to their respective trash based on their clustering.

III. PROPOSED SYSTEM

The Load cell or strain gauge calibrated and used to calculate the weight of the food waste. HX711 to Node MCU data can be multiplied (ESP8266). Via the Node MCU, measured data can be sent to a local server. The data is handled by the Node MCU, which acts as a microcontroller. Data will be sent to the archive after it has been retrieved. The weight calculation is shown using an OLED monitor. Data can be saved locally and shown on a web page. To compare and train the datasets, we used the Random Forest algorithm [13]. Based on real-time analysis of data that is being lost in hostel messes, a trained dataset can be used to estimate the accuracy rate of food wastage [14]. This forecast can be used on the manufacturing line to reduce food waste. Used concepts are listed and discussed in the below section.

A. Internet Of Things

The Internet of Things (IOT) is a term that refers to a collection of physical and virtual devices that can capture and transmit data over a wireless network without the need for human intervention. Computing devices and digital computers are linked together by a special and precise identifier that allows data to be transferred from one location to another. IOT based ecosystem consists of various web-enabled kind of smart devices that save, to allocate and use the embedded based systems including the processors, the sensors, and the communications related hardware to the data from their surroundings. An IOT sensors connect to an IOT or other edge node, which can then be transported to the cloud or analysed locally, for the sharing of sensors. For making calculations, many existing weighing systems depend on the phase reaction of one or more force transducers [15]. Force transducers, on the other hand, may have a long settling period, limiting the overall measurement rate. The effect of an object on a load cell is used in this paper to demonstrate a weight calculation technique. Since the Dirac delta function will approximate the impact impulse, the output looks like the impulse response. This impulse response can be used to estimate the size of the impact impulse and the object's weight. The long oscillatory reaction of the force transducer is eliminated by signal processing.

B. RANDOMFOREST

The Random forests method or the random based decision-making forests are a group oriented learning approach to identify, re- regress and other functions, which work by building numerous decision trees during training and by creating the class mode or medium-average projection between the different trees. Random decision forests are correcting their training in deciding tree habits, but, their level of accuracy is poor when compared to the gradient-enhanced based trees. The random based forest predictors which are naturally lead to a degree of differentiation between observations. The aim is to construct a random forest predictor that differentiates the observed data from properly produced synthetic data, which can also describe a random forestry based dissimilarity related measure between the unlabeled details. It can be attractive to random based forest differences, since it can handle mixed variable forms in good manner, it is invariant for monotonous changes in input variables and it is robust to external observations. The random forest dissimilarity can conveniently address a wide range of semi-continuous variables due to its inherent variable set.

C. CONFUSION MATRIX

An intermediate matrix is an engine learning classification output analysis methodology. This is a kind of table that allows you to learn the classification model's output on a collection of test results, so that true values are understood. The word confusion matrix is clear, but it may be a little misleading about its associated terms. A basic explanation for this technique is given here. Confusion matrix is a helpful machine learning[3] tool for measuring recall, precision, precision and AUC- ROC curve. Below is an example of the concepts True Positive, True Negative and True Negative.

- **Positive Predictive Value (PVV):**

That's very close to accuracy. The PVV considers the prevalence as a substantial distinction between two terms. The optimistic predictive value is same as accuracy in situations where classes are perfectly equal.

- **F Score**:

F1 score means an overall weighted score of real good (recall) and accuracy.

- **Precision:**

The accuracy parameter indicates the accuracy of the positive class. It tests how probable the optimistic class prediction is correct. The highest score is 1 if the classifier categorizes all positive values
in perfect order. Accuracy alone is not advantageous when the derogatory class is overlooked. Typically the metric is combined with the metric recall. Remembering the sensitivity or true positive rate is often named.

- **Sensitivity**: The ratio of correctly detected positive groups is computed using sensitivity. The model's ability to classify a positive class is measured using this metric.

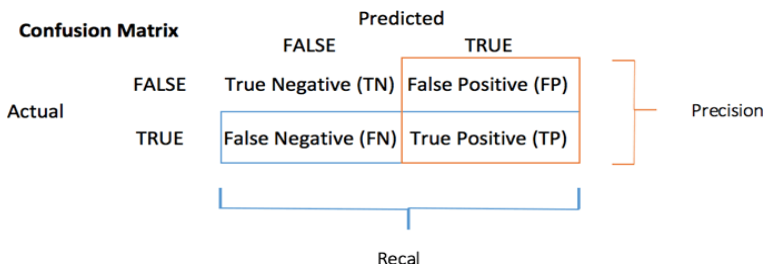


Figure: 1 Confusion Matrix

$$Precision = \frac{TP}{TP + FP} \qquad Recall = \frac{TP}{TP + FN}$$

IV. METHODOLGY

We use machine algorithms to analyze from real time food wastage data to predict the time line of wastage so that we can reduce the wastage of food. The average amount of the food waste is calculated and measured approximately through the load cell. The HX711 to Node MCU data transfer can be amplified (ESP8266). Via the Node MCU, measured data can be sent to a local server. For data processing, the Node MCU serves as a microcontroller. Data will be sent to the archive after it has been retrieved. The weight calculation is seen on an OLED display. Every calculated food waste data is transmitted and stored in the server. The data which has been fetched from strain gauge can be used to compare the present data and past data can be used to predict the accuracy rate of the food waste. After the comparison of both data, prediction rate has been generated which is used to reduce the food waste certain manual calculations on the production desk, so that we can reduce the gross rate for the next time of preparation and also create awareness among the people. The Local Server and the sample dataset is shown below.

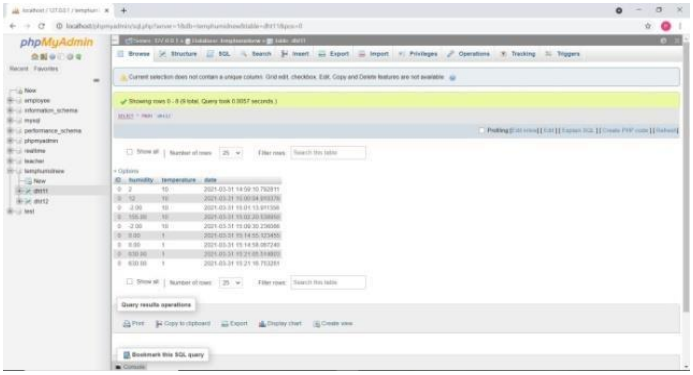


Figure: 2 Local Server

[ ]

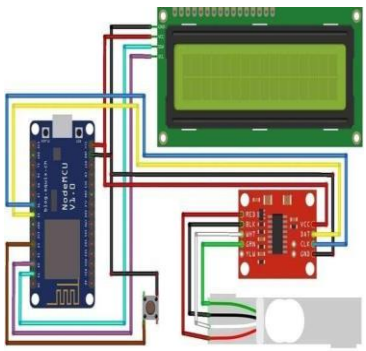
	Sl.no	ID	T.Weight	L.Weight	date	112th	year	day
0	1	1	4	544	1	1	2020	114
1	2	1	5	362	2	1	2020	115
2	3	1	6	546	3	1	2020	116
3	4	1	7	245	4	1	2020	117
4	5	1	8	663	5	1	2020	111

```
[ ]  #to display how many rows and columns in the dataset
     dataset.shape

     (5114, 8)

[ ]  X = dataset.iloc[:, 0:4].values
     y = dataset.iloc[:, 4].values
```

Figure: 3 Dataset

V. CIRCUITDIAGRAM

The working model and circuit flow diagram to do the processing of our work is given below:



VI . FLOWCHART

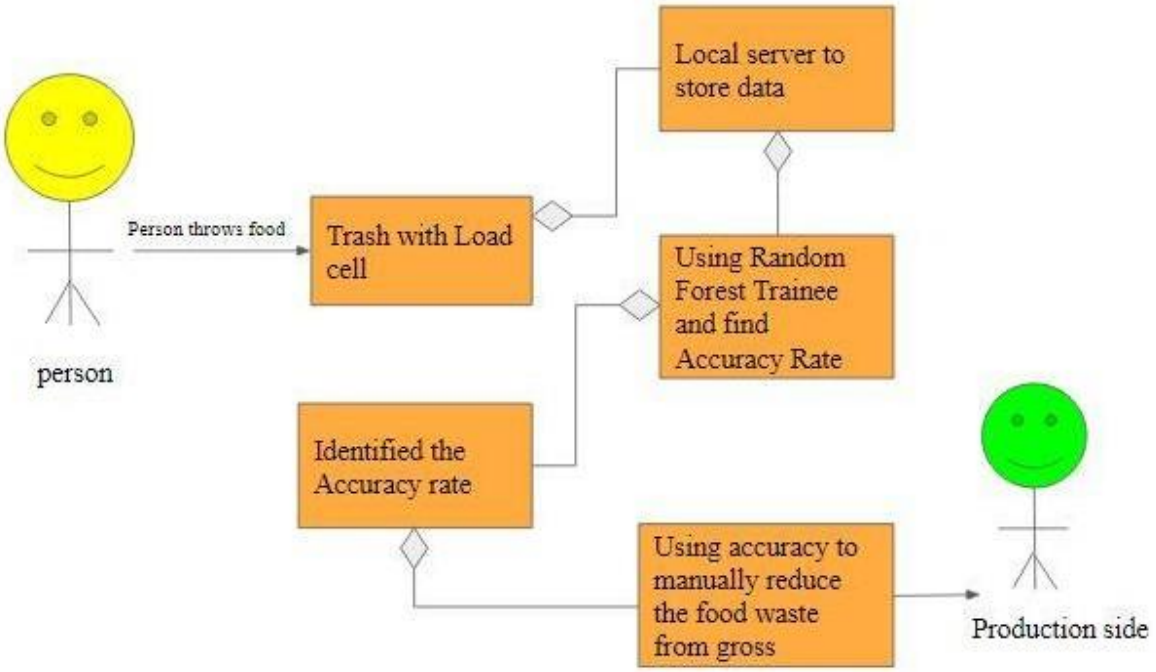


Figure: 5. Flow diagram

The above diagram explains the workflow model of our proposed work

VI. ANALYSIS ANDDESIGN

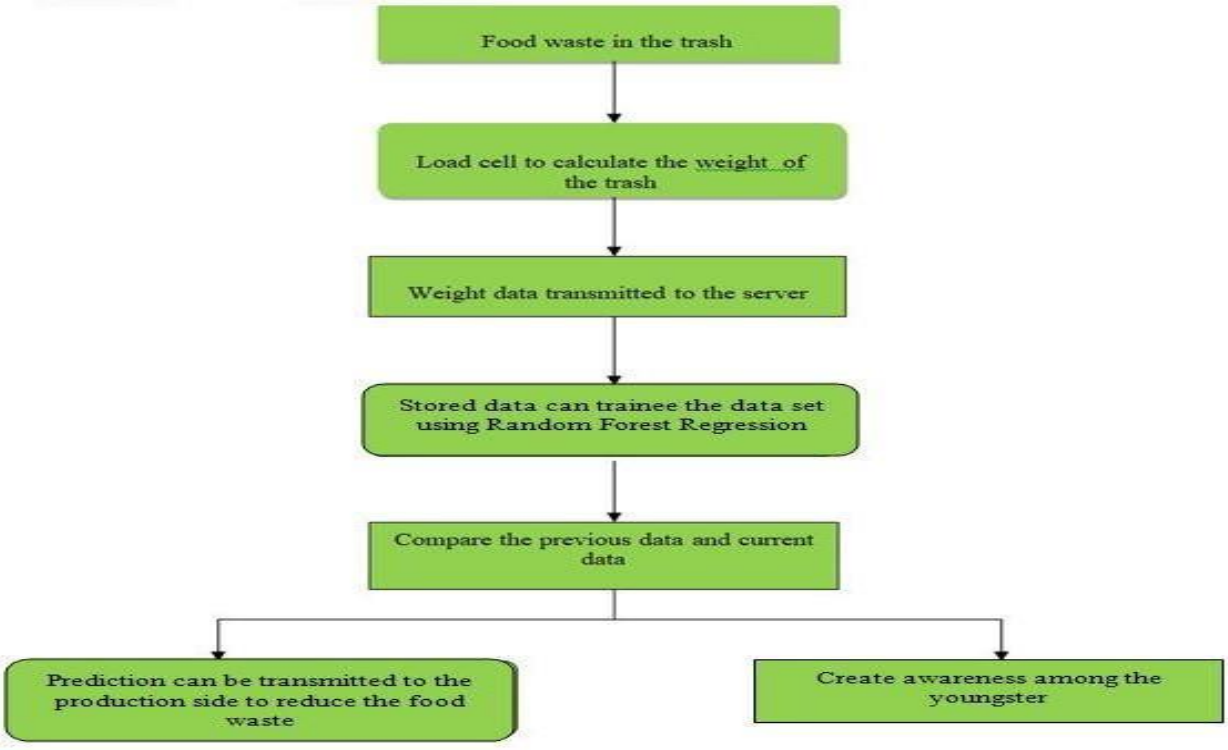


Figure: 6.Uml diagram

The analysis and design to execute the process model was shown in the above diagram

Procedures:

Step 1: Person put food on trash**.**

Step 2: Trash carries load cell to measure weight.

Step 3: Measured data can be transmitted to Node MCU

Step 4: NodeMCU act as WIFI module to transmit data from Local server.

Step 5: Transmitted data can be stored in Local Database.

Step 6: Through that data Using Random Forest regression to predict the accuracy rate by comparing thedata.

Step 7: prediction can be used to reduce the food waste by reducing it from gross quantity on production side**.**

VII. CONCLUSION AND FUTURE WORK

We can efficiently manage the food waste in huge amount by introducing our innovation in public food courts and hostel messes. Through that we can manage the food waste through the predicted accuracy rate of the food waste. Our future work has huge advantage, because introducing the camera to capture picture to clustering the waste food to separate them, through that we can reduce that particular item from the chart of the production site. Future work has huge advantage, because introducing the camera to capture picture to clustering the waste food to separate them, through that we can reduce that particular item from the chart of the production site.

IX. REFERENCES

[1] P.Manjunathand P.G.Shah,"IOT Based Food Wastage Management System,"2019 Third International conference on I- SMAC (IoT in Social, Mobile, Analytics and Cloud), Palladam, India, doi:10. 1109/ISMAC47947.2019.9032553, 2019

[2] H. Agarwal, B. Ahir, P. Bide, S. Jainand H.Barot, "Minimization of Food Waste in Retail Sector using Time-SeriesAnalysisandObjectDetectionAlgorithm,"2020 International Conference for Emerging Technology (INCET), Belgaum, India, doi:10.1109/INCET49848.2020.9154156, 2020

[3] Syed Musthafa.A, "E-Agricultural System based Intelligent Predictive Analysis and Smart Farming with Digitalized Demand and Supply utilization to maximize the yield rate of crops using Machine Learning Algorithm", Turkish Journal of Computer and Mathematics Education, Volume12, No.10 (2021), page 2036-2041, may 2021

[4] D.Dilkhush Mihirsen,J. T.Joseph and ilman and G. Bailey, "High-speed Weighing Using Impact on Load Cells," TENCON 2005 – 2005 IEEE Region 10 Conference, Melbourne, VIC, Australia, 2005, pp.1-6, doi:10.1109/TENCON.2005.301118.

[5] S Sengan, A Syed Musthafa, "A Fuzzy based High-Resolution Multi-View Deep CNN for Breast Cancer Diagnosis through SVM Classifier on Visual Analysis", Journal of Intelligent & Fuzzy Systems, IOS Press, 10.3233/JIFS-189174, Page 1-14, 2020 .

[6] Hong, I.,Park, S.,Lee, B.,Lee,J.,Jeong,D., &Park,S IOT-Based Smart Garbage System for Efficient Food Waste Management. The scientific, World Journal, 113.doi:10.1155/2014/646953, 2014

[7] Syed Musthafa.A , "Kidney Disease Detection Using Machine Learning", Turkish Journal of Physiotherapy and Rehabilitation; volume 32(2), ISSN 2651-4451, page 3359- 3365, may 2021.

[8] U. S. Shanthamallu, A. Spanias, C. Tepedelenlioglu and M. Stanley, "A brief survey of machine learning methods and their sensor and IoT applications," 2017 8th International Conference on Information, Intelligence, Systems & Applications (IISA), doi: 10.1109/IISA.2017.8316459,2017

[9] Syed Musthafa A, Abdul Jaleel D, "Tourist Spot Proposal System Using Text Mining", International Journal of Advanced Trends in Computer Science and Engineering, Volume 9, No. 2, ISSN 2278-3091, Page 1358- 1364, April 2020

[10] R.Bharathi, T.Abirami," Energy efficient compressive sensing with predictive model for IoT based medical data transmission", Journal of Ambient Intelligence and Humanized Computing, November 2020, https://doi.org/10.1007/s12652-020-02670-z

[11] Syed Musthafa Akbar Batcha, Pankaj Dadheech& Sudhakar Sengan , 'Utilizing Index-Based Periodic High Utility Mining to Study Frequent Itemsets", Arabian Journal for Science and Engineering (2021), ISSN: 21914281, July 2021

[12] Syed Musthafa.A, “Securing data in transit using data-in-transit defender architecture for cloud communication”, Soft Computing (2021), ISSN: 14327643, 14337479, doi.org/10.1007/s00500- 021-05928-6, june 2021

[13] R. S. Kumar, S. M. A., A. Balaji, G. Singh, A. Kumar and M. P, "Recursive CNN Model to Detect Anomaly Detection in X-Ray Security Image," 2022 2nd International Conference on Innovative Practices in Technology and Management (ICIPTM), 2022, pp. 742-747, doi: 10.1109/ICIPTM54933.2022.9754033.

[14] PardiniK, Rodrigues JJPC, Kozlov SA, Kumar N, Furtado V. IoT-Based Solid Waste Management Solutions: A Survey. Journal of Sensor and Actuator Networks. 2019

[15] A. S. Musthafa, M. Ambika, A. KN, D. M, I. M and P. R, "Oryza Sativa Leaf Disease Detection using Transfer Learning," 2022 International Conference on Sustainable Computing and Data Communication Systems (ICSCDS), 2022, pp. 1-7, doi: 10.1109/ICSCDS53736.2022.9760972.

[16] K. Amudha, A. Syed Musthafa, Dilip Kumar Sharma, Edwin Hernan RamirezAsis, Priya Velayutham, V, “An Sampath AK 5656 Optimized Fuzzy based Ant Colony Algorithm for 5G -MANET”, Computers, Materials & Continua, Volume 70, issue 01, DOI:10.32604/cmc.2022.019221, 202 1

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