Data and Metadata. 2023;2:161
doi: 10.56294/dm2023161

ORIGINAL

Machine Learning Model for Prediction of the Chemicals Harmfulness on Staff and Guests in the Hospitality Industry: A Pilot Study

Modelo de aprendizaje automático para predecir la nocividad de los productos químicos para el personal y los clientes de la industria hotelera: Un estudio piloto

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Cite as: Mr. Rohit, Sethi K, Khan M, Raina A. Machine Learning Model for Prediction of the Chemicals Harmfulness on Staff and Guests in the Hospitality Industry: A Pilot Study. Data and Metadata. 2023;2:161. https://doi.org/10.56294/dm2023161

Submitted: 31-08-2023 **Revised:** 17-10-2023 **Accepted:** 29-12-2023 **Published:** 30-12-2023

Editor: Prof. Dr. Javier González Argote

ABSTRACT

This article examines the trend around the adoption of machine learning in the hotel business in light of the significance of new technologies. According to previous research, the hospitality industry uses a variety of chemicals for cleaning. Cleaning supplies are the housekeeping department's primary tool in their daily routine to keep rooms and common areas clean and tidy. Guest and staff don't know the harmfulness of these chemicals. Providing hospitality that meets the needs of guests requires not only a positive attitude, but also high-quality and excellent services that keep guests warm, relaxed, and comfortable. But in some incidents, we find that the guest and staff health is affected by the chemicals. Also, no one worked on predicting the chemical's effects on staff and guest health in the hospitality sector with the use of Machine Learning models. For this purpose, data is collected from different hotels of Delhi NCR in India. There were two distinct fields utilized for assessment and instruction. For the investigation, machine learning methods were employed. The research project employed five machine learning methods. The newly developed MHC-CNN algorithm achieved the highest accuracy (93,75) in comparison to other cutting-edge machine learning techniques. The created technique can be expanded upon and applied in many hotels all around the world.

Keywords: Algorithm; Chemicals; Employee; Harmfulness Hotel; Learning; Machine; Technologies.

RESUMEN

Este artículo examina la tendencia en torno a la adopción del aprendizaje automático en la hostelería a la luz de la importancia de las nuevas tecnologías. Según investigaciones anteriores, el sector hotelero utiliza diversos productos químicos para la limpieza. Los productos de limpieza son la principal herramienta del departamento de limpieza en su rutina diaria para mantener las habitaciones y las zonas comunes limpias y ordenadas. Los huéspedes y el personal desconocen la nocividad de estos productos químicos. Ofrecer una hospitalidad que satisfaga las necesidades de los huéspedes requiere no sólo una actitud positiva, sino también servicios excelentes y de alta calidad que mantengan a los huéspedes cálidos, relajados y cómodos. Pero en algunos incidentes, descubrimos que la salud de los huéspedes y del personal se ve afectada por las sustancias químicas. Además, nadie ha trabajado en la predicción de los efectos de los productos químicos en la salud del personal y de los huéspedes en el sector de la hostelería con el uso de modelos de aprendizaje automático. Para ello, se recopilaron datos de diferentes hoteles de Delhi NCR en la India. Se utilizaron dos campos distintos para la evaluación y la instrucción. Para la investigación se emplearon métodos de aprendizaje automático. En el proyecto de investigación se emplearon cinco métodos de aprendizaje automático. El algoritmo MHC-CNN desarrollado recientemente obtuvo la mayor precisión (93,75) en comparación con otras técnicas de aprendizaje automático de vanguardia. La técnica creada puede ampliarse y aplicarse en muchos hoteles de todo el mundo.

Palabras Clave: Algoritmo; Productos Químicos; Empleado; Nocividad Hotel; Aprendizaje; Máquina; Tecnologías.

INTRODUCCIÓN

Hospitality is vital to the development of every nation, hotels are undoubtedly one of the tourist business's largest divisions and are its main source of income.[1] Hospitality and lodging have long been intertwined, and there are currently a large number of hotels available, adding more visitors' access to the worth and choice within the area.[2] The location or existence of a hotel is not enough to uplift the tourism of an area, but it also indicates health tourism. The four sectors of hotels, meals and drinks, travel and tourism, and leisure of the hospitality industry.[3] Hotels, restaurants, activities, entertainment, cruises, and other services may be included. The overarching goal in all of these areas is to provide the consumer with a pleasant and comfortable experience while also delivering essential services.[4] Hotel management's top priority and concern is that all guests are treated with kindness and hospitality. If he doesn't get treated right, he won't come back and will choose to do business with a competitor.[5] It also has the potential to influence other people not to stay at your hotel, which is a big influence. Therefore, each guest should be treated with respect and a satisfactory stay should be provided. Hospitality is also important for businesses as it leads to positive customer reviews. Most consumers look for online reviews before purchasing an alternative product or service.[6] Guests may leave negative reviews if the hotel service is poor and poor. Unfortunately, a small number of negative reviews can significantly impact your hospitality business. Hospitality is a key concern for both guests and hotel operators. Every guest expects and deserves hospitality, so we are here for you 24 hours a day. Providing hospitality that meets the needs of guests requires not only a positive attitude, but also high-quality and excellent service that keeps guests warm, relaxed, and comfortable.[7] The hotel restaurant always offers a simple breakfast that is healthy and hygienic.[8] But most of the time Hospitality doesn't care about the staff health and guest health. The hospitality industry uses a variety of chemicals and fuels, including detergents, sanitizers municipal gas, and cleaners for drains. Improper handling of chemicals can cause work-related injuries to employees. Appropriate safety measures must be taken to safeguard of employees.[9] In this connection, employers may seek advice from safety experts if necessary. These guides are intended as a reference for hospitality management or safety personnel to read to help users become aware of the risks associated with the usage of chemicals in the lodging industry and to implement efficient prevention measures. Several kinds of cleaning agents are used in the hospitality industry, including soaps, detergents, ammonia solutions, acids, and alkalis. Some chemicals can cause itching and skin burns.[10] Acidic and alkaline cleaning agents in high quantities are corrosive and can burn the skin and eyes when they come into contact in rare instances, domestic chemicals are used to eradicate or control pests in lodging facilities. These goods include hazardous substances called pesticides. Appropriate safety precautions should be taken when using chemical pesticides. There are currently several latest developments and focal points in the hotel industry. The use of technology is having a major impact on the hospitality industry, from how guests book their accommodations to what they receive during their stay. It is crucial for the hospitality sector to be up to date on the most recent technical developments as the usage of cellphones and other devices rises Technology is essential to the hospitality sector, offering quick and practical solutions for a range of jobs, from making reservations to running the business and enhancing the guest experience. Here are some of the key areas where information technology is impacting the hospitality industry, including online reservations and reservations, mobile technology, customer relationship management (CRM) systems, and in-room technology.[11] AI (artificial intelligence) is used in some hotels around the world.[12] With the help of AI, tasks such as room service, cleaning, and maintenance can be automated. It can also personalize the guest experience by anticipating guest preferences and offering customized services. But there no research is present that works for predicting the chemical effects on staff persons and guest health in the hospitality sector with the use of Machine Learning models.

The sector of hospitality industry encompasses many industries that care about the circumstances and stay of their customers. Examples include hotels, hospitality, parks, amusement centers, and tourist centers. It has been confirmed that chemicals, mainly detergents, are usually used in these places, and it is necessary to have sufficient knowledge about their use, as improper use may cause health hazards.[13] Many chemical products are common in the hospitality industry, all-purpose cleaning products, ammonia-based cleaners, chlorine dioxide, metal polishes, dish soaps, sanitizers, drain cleaners, and deodorants are among the cleaning products that can be found in a home.[14] Listed below are typical chemical agents (Table 1) in products used by hotel employees. A harmful chemical, as defined by WHS laws, is any substance, mixture, or product that satisfies the requirements for one or more (Globally Harmonized Standard of Identification and Labelling of Chemicals) hazard classes. This includes WHS Schedule 6 classification.

Infectious materials (Division 6.2), most Class 9 hazardous goods (Miscellaneous Goods), and compounds

that only provide radioactive threats make up the majority of substances and mixtures that are categorized as hazardous under the ADG levels Code). Except for dangerous chemicals. In the hotel sector, cooking fuels like petrol, Liquid Petroleum gas, are frequently used.[16] Food is frequently heated and reheated using alcohol as a fuel.[17]

Table 1. Chemicals Classification and their uses in hotel industries

TASKI R1 / Diversey R1	Cleaning and Sanitizing of Bathroom / Toilet surfaces
TASKI R2 / Diversey R2	All-purpose cleaning agent / Hygienic Hard Surface Cleaner
TASKI R3 / Diversey R3	For Cleaning Glass and Mirror Cleaner
TASKI R4 / Diversey R4	For Furniture Polish and Cleaning / Furniture Maintainer
TASKI R5 / Diversey R5	Air Freshener / Room Freshener / Bathroom Freshener
TASKI R6 / Diversey R6	Heavy-duty toilet bowl/urinal cleaner for the removal of limescale, stains, and other residues.
TASKI R7 / Diversey R7	For removal of oil and grease from floor / Non-abrasive cream cleaner for water-resistant hard surfaces
TASKI R8 / Diversey R8	Kettle Descaler - Highly effective acid-based descaler for kettles, kitchen equipment, shower heads, etc.
TASKI R9 / Diversey R9	Fully formulated cleaner for cleaning all fittings and walls in the bathroom, sink, tub, tiles, and fittings.

Hospitality workers need to use different types of cleaning agents and fuels in their jobs (Table 1). Some of these cleaning Agents may be hazardous to your health, abrasive volatile, and toxic. Appropriate safety measures must be taken to safeguard the health and safety of employees. When it comes to chemical's inherent features that have the potential to negatively impact living things or the environment are referred to as its hazards. Hispanic workers in the United States face obstacles and dangers at work, particularly in the lodging industry. 14,3 million of her jobs are in the hospitality and tourist sector in the US.[2] There are 561 000 latino workers in the hotel sector, and half of them are Latina women. Of these Latin American accommodation workers, 41 % perform cleaning duties in the cleaning departments of hotel facilities, which is often considered "dirty" work.[2] While the job of cleaning hotel rooms is physically demanding, the pay is low, with her average annual income of US$19 570. In addition, employees are exposed to a variety of physical risks and psychosocial stressors in their work environment, as well as chemical and biological agents that can cause respiratory, skin, and infectious diseases are also exposed to toxic substances. Hotel housekeepers typically change postures every 3 seconds while cleaning a room, resulting in 8 000 different postures for each 8-hour shift. At the same time, the time pressure associated with hectic work leads to the fact that housekeepers are exposed to high aerobic loads, strong static muscle activity, body movements, and excessive physical exertion. The housekeeper had the maximum MSD infection rate across the board for hotel staff, with 3,2 him per 100 employees. According to Fletcher et al.[18] found that floor-sweeping increased cardiovascular work (53 % of highest oxygen uptake [VO2 max]) to a level exceeding the international laboratory guidelines (33 % of VO2 max). Various convenience improvements have been made because the housekeeping work is more tiring. Through research work, we found, more than 75 % of the 258 participants said they had pain from their jobs. Of those, 73 % had to get healthcare for severe pain, and 53 % had to take time from work to heal. Participants reported an average injury absence of 14 days. Another study revealed that household heads of all ages experienced pain from their jobs.[19] It is believed that this physical pain interferes with daily life and forces workers to take pain relievers regularly, even when they are not working.[20]

Work of Machine Learning Application in the Hotel Industry

The growing popularity of online hospitality platforms gives businesses first-hand knowledge of customer preferences.[22] This is important for improving hotel services and increasing the perceived quality of services. You may effortlessly gather the most important parts of the service experience for your hotel's customers using customer ratings. In this report, We suggest a methodology for assessing customer reviews on the level of service in the lodging industry using machine learning as well as natural language processing methods.[23] Every day, as people come and search the site for hotels, countless data points are generated. By aggregating and analyzing this data, you can uncover each customer's journey to purchase. If hoteliers have access to this information, it opens up business opportunities and sales potential. It takes a lot of time and effort to collect and analyze all of the info required to obtain this knowledge.[24,25] The adoption of machine learning, or AI, technology has the prospective, and in many cases, will, to completely change the hotel sector.[2] contribute to this space by providing AutoML tools for the hospitality industry. Given the prevalence of AI in the current period, the main

https://doi.org/10.56294/dm2023161

practical value of AutoML is its capacity for forecasting consumer response (satisfaction, loyalty, etc.) and revenue from loyal customers.[26] A lot of machine learning methods were taken into consideration to build a model to predict daily hotel occupancy based on past bookings and occupancy records.[27,28] Different methods for building datasets and validating models are explored.[5]

Research Gap

- Hazards associated with chemical misuse.
- Recent accident statistics due to inappropriate use of cleaning agents & laundry agents in the hospitality sector.
- Failure of hospitality employees to know hazardous chemicals that are harmful to industry employee health and environmental factors.
- Very little use of technology for the prediction of the health of the staff and guests.

METHODS

This section presents each component of the proposed framework for the current work i.e. shown in figure 1.

Hotel Dataset

This research presents a novel dataset named the hotel dataset. The sampling frame included 15 local hotels (Delhi NCR), including 5-star and 4-star hotels. A set of 27 questions, were used to gather data from various hotels in the region of Delhi NCR. Six criteria form the basis of the questions, as shown in table 2: geographic features, health background features, hotel domestic features, personal features, chemical perspectives, and occupational features. The hotel dataset consists of data collected from 550 staff and guests of different hotels.

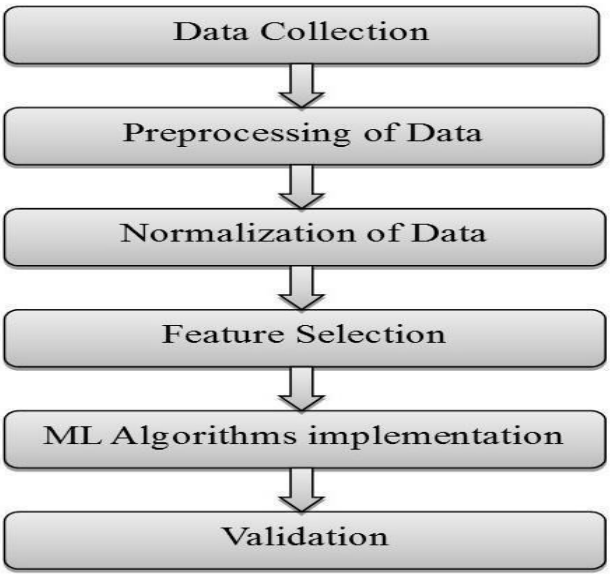

Figure 1. Schema of Research Process

Table 2. Hotel Dataset feature and their description

Feature category	Feature	Description
Geographical Features	Belonging Area	Staff & guest areas where they belong?
	Hotel Location	Location of the hotel where they are working?
Health Background features	Health issue	While working in the hotel?
	Physical fitness	Physically challenged or not?
	Previous health issue	Before joining the hotel?
	Health issues include	Allergies, asthma, kidney failure, cancer, itching, etc.
Hotel Domestic Features	Staff strengths	A total staff of the hotel?
	category	Star category of the hotel?
	Working Area	In which area do they work?

Personal Feature	Education	Qualification of staff?
	Age	Age range (18-56 years)
	Working tenure	How long has staff working with this hotel?
Chemicals Prospective	Most effective chemicals	The staff has notified the effective chemicals
	Harmful chemicals	Staff deal with any harmful chemicals?
	Storage	Is in a hotel any specific area for chemical storage?
	Chemicals color	Guest identifies the chemicals with color
	Categories of chemicals	Which types of chemicals are used in hotels?
	Chemicals effects	Sneezing, eye itching, skin itching, skin resins, etc.
Job-Related features	Health checkup	Does the hotel provide the facility to check your health from time to time?
	Shift timing	Working hours of an employee

Data Preprocessing

Data Preprocessing is a significant step for the presented study to overcome the issues of ambiguous/ duplicate or missing data. The instances consisting of missing entries or ambiguous data were removed from the dataset using standard Python functions for the same. Since data from both hotel staff and guest domains were collected separately, the data should be converted from textual to numeric form using the MHC algorithm suggested in Section 3.3.5.

Normalization

Normalization was performed to normalize the data, followed by data preprocessing to remove outliers and improve classification/prediction accuracy. The normalization equations used for this study are:

$$Z=(x- \bar{x}) / (\text{std } (x)) \quad (1)$$

Where $\bar{x}$ is the mean and std(x) calculates the standard deviation of *x* (set of features).

Characteristic Choice

Selection of features via score screening Each characteristic matrix is given a rating using a rating mechanism. The score of the vector of features increases as the score function's value increases. Matrix denotes the importance of a vector of features in such a way that a vector of features with a higher rank is more important than a vector of features with a lower rank after a threshold has been set to filter out the least important vector of features. Feature selection was made by his WEKA software using principal component analysis (PCA). The step is used for selecting the optimal feature set for shallow classifiers, as used in the study for comparing them with the proposed one. The advantage of the proposed MHC-CNN is that it automatically selects the best feature set for classification.

Machine Learning Algorithms

Generally, Automated learning techniques require labeled data for training the model. The Hotel dataset was divided into two parts: Test and training data. The training data was used for training the model whereas the testing data was used for validating the trained model. From the literature, it was found that the Support Vector Machine, K Closest Neighbour, and Feed Forward Neural Networks and Naive Bayes algorithms were used in this domain, predominantly. The current study compares the performance of MHC-CNN with all the algorithms mentioned above.

Support Vector Machine (SVM)

SVM is the most commonly uses algorithm in various investigations. SVM uses a kernel function (RBF) that is mathematically defined as in Equation 2 for better results.

$$k(x,x')=\exp[-(\|x-x\|2)/(2\sigma^2)] \quad (2)$$

where K is the RBF kernel value in the range 0 to 1. On the other hand, x & x' are the feature vectors and σ2 is the standard deviation.

The model that was developed is validated using validation data, and the model is scored using test data to calculate outcomes including precision, compassion, reliability, and Matthews correlation coefficient

Feed Forward Neural Networks (FFNN)

The students' dataset is a supervised dataset. In this condition, feed-forward neural networks can be used easily for model generation. Because it is mostly used for supervised ML tasks. In a neural network, two simple methods are present which are feed-forward and backpropagation. In the current research, we used the feed-forward method because it takes the information into the forward direction and it takes very little time to show

https://doi.org/10.56294/dm2023161

the output. For FFNN we have used 13 hidden layers.

Input x = [x_0, x_1, x_2, x_3 …x_{550}] Output y = [0,1]

Training a neural network:

1) Randomly set weights.

2) Apply forward propagation to get h(x(i)) for any x(i) using the given equation 3.

3) Compute cost function (θ).

Initial

For i = 1: m

$h\theta$(x)=1/(1+e)$^{(-\theta Tx)}$ (3)

//performed feed-forward propagation using//

Input is (x^i, y^i)

Ending

k- Nearest Neighbor

k- Nearest Neighbor is the most imperative for classification in ML. It is very easy to implement and helpful for model generation because it does not need any training data points. It trains the data faster but slower in testing. It classifies the new data on the basis of similarity measures. In k- Nearest Neighbor k means positive integer. We used K=1 for the study.

Naive Bayes

The Bayes theorem is the foundation of naive Bayes classifiers.[12] The Bayes theorem calculates the likelihood of an event based on previous occurrences. Bayes' Theorem is stated as

$$P(A|B) = (P(B|A) * P(A)) / P(B) \quad (4)$$

where P(A|B) is the probability of A given that event B has already occurred. P(A) is the probability that A occurs, which we call the prior probability. P(B) is the probability of event B occurring.

Proposed Framework

According to our proposed framework, is divided into two main parts i.e. converting text data to numerical form using the proposed Modified Huffman Coding (MHC) algorithm and second is the implementation of the newly developed deep learning architecture for predicting the chemical hardness on staff and guest.

Modified Huffman coding Algorithm

Huffman coding is a well-organized method of compressing the data and it provides an efficient, unambiguous code by analyzing the frequencies. The proposed MHC algorithm uses the Huffman encoding to assign unique codes to the text data for each column of the dataset which was then converted to its numerical form using standard binary to decimal conversion. The proposed MHC algorithm for text-to-numerical conversion and converted numerical as well as normalized values from the text, respectively.

Start

Step 1: select one feature and count the value of the frequency.

Step 2: sort the frequency in reverse order

Step 3: collect all average values and assign name and code for the tree Step 4:

function for the right side and left side of the tree.

4.1 self. left.get_codes(h+1, code+'1', result)

4.2 self.right.get_codes(h+1, code+'0',result)

4.3 def height(self, h=1):

hl = hr = 1, if self.left != None:,

hl = self.left.height(h+1), if self.right != None: hr = self.

right.height(h+1), return max(h, hl, hr),

4.4 def swap(self):

if self.left == None or self.right == None: return,

if self. left.height() > self.right.height():, self.

left, self.right = self.right, self.left, self.left.

swap(), self.right.swap()"

4.5 def merge_nodes(nodes):

4.6 return result

Step 5: use the code for frequency values

Step 6: convert the values into binary to Decimal form

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End

Deep Learning Architecture

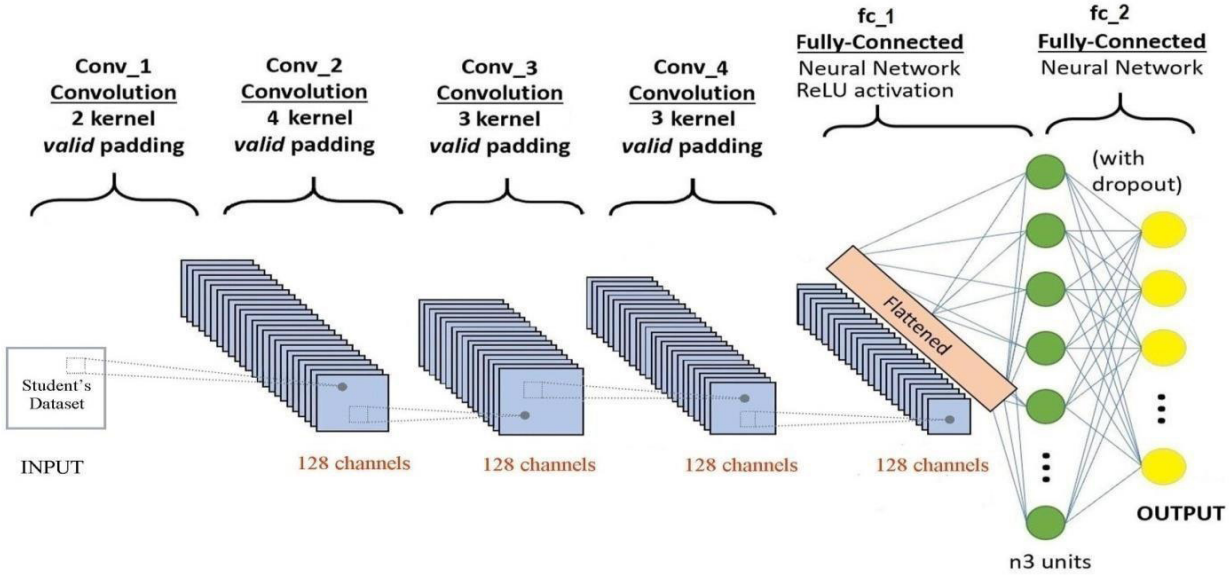

Figure 2. HCCNN chemicals hardness predicting based Convolutional Neural Network

The proposed framework consists of 15 layers, including four layers of convolution, batch normalization, rule activation, dense layer, and fully connected layer. 128 filters of filter size make up the first convolutional layer (2), a second of 128 filters of filter size (4), a third of the same number of filters of filter size (3), and a filter of size (3) consists of the 4th of 128 filters. Same filter size as the 3rd. Finally, we used the SoftMax classifier to classify the data into two classes: employees and guests. We tuned the model using the Adam optimizer to improve performance metrics. Details of the proposed architecture are shown in figure 2.

Performance Matrix

The performance matrix used in this study is Accuracy, Specificity, Sensitivity, and Mathews correlation coefficient whose mathematical equations are given below.

$$\text{Accuracy} = TP / P+N \quad (5)$$

TP= True Positive, P= Positive, N= Negative

$$\text{Specificity} = (TN) / (TN + FP) \quad (6)$$

TN= True Negative, FP = False Positive

$$\text{Sensitivity} = (TP) / (TP + FN) \quad (7)$$

TP= True Positive, FN= False Negative

Matthews's correlation coefficient (MCC)

$$MCC = (TP*TN-FP*FN) / \sqrt{((TP+FP)(TP+FN)(TN+FP)(TN+FN))} \quad (8)$$

TN= True Negative, FP = False Positive, TP= True Positive, FN= False Negative

RESULTS

The proposed study aimed at collecting data from the different hotels from different locations in India besides asking different questions and using it for building a machine learning model. The data was collected from 550, out of which 240 data is related to the staff and remaining from guests. Collected data are further annotated by converting text to numbers using the proposed algorithm, as shown in figure 3.

				A	
1	Urban	4 star	No	Kitchen area	Less than 7 hours
2	Urban	4 star	No	Front office	8 to 10 hours
3	Sub urban	5 star	Yes	Housekeeping	10 to 12 hours
4	Rural	Other	No	Kst	More than 12 hours

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B					
1	1	1	0	1	2
2	1	2	0	1	0
3	2	3	1	1	1
4	4	4	0	1	2

C					
1	0,252407	0,030965	0,177596	0,341226	0,112462
2	0,252407	0,030965	0,177596	0,341226	0,112543
3	0,033307	0,030965	0,177596	0,341226	0,113457
4	0,252407	0,030965	0,677596	0,67456	0,112462

Table 3. Top part is text format data (**A**), the middle part shows the coded data (**B**) and the lowest part shows the normalized data (**C**)

Equation 1 is used to conduct normalization which is described in Section 3 to fit the values to a standard scale for effective prediction. The best features were selected using PCA,[12] except for the suggested ones. Finally, the data is split,90 % of the results are employed for the training of models, and the other 10 percent are used for model validation and testing, resulting in a 9:1 ratio. The algorithms used for the study i.e. SVM, FFNN, k-NN, NB, and MHC-CNN. Linear SVM was used as this was giving the best performance among RBF as well as Polynomial kernel-based SVM, the rest of the algorithms do not possess any variant, so the other algorithms were used as such. According to Table 3, the FFNN gives 86,72 % accuracy with a specificity of 0,82, sensitivity of 0,91 and MCC is 0,72. SVM gives an accuracy of 75,02 % with 0,82 specificity, 0,87 sensitivity and 0,68 MCC. KNN performed well as compared to the SVM with 83,52 % accuracy but low in specificity, sensitivity, and MCC i.e. 0,78, 0,90, and 0,70. In this research, our MHC-CNN outperformed all other algorithms achieving with the accuracy, specificity, sensitivity, and MCC of 93,75 %, 0,90, 0,94, and 0,81, respectively. The worst performance was performed by NB with the lowest accuracy, specificity, sensitivity, and MCC. Figures 5, 6, 7, and 8 depict the performance of the trained model in terms of accuracy, specificity, and sensitivity. Figure 4 shows the summary of the MHC-CNN.

Table 4. Accuracy, Specificity, Sensitivity, and MCC achieved on the Hotel dataset using the proposed method

Method (Datasets)		Train 90 %	Test 10 %	Accuracy (%)	Specificity	Sensitivity	MCC
FFNN	Hotel	495	55	86,72	0,82	0,91	0,72
SVM	Hotel	495	55	75,02	0,82	0,87	0,68
KNN	Hotel	495	55	83,52	0,78	0,90	0,70
MHCCNN	Hotel	495	55	93,75	0,90	0,94	0,81
NB	Hotel	495	55	66,25	0,62	0,58	0,59

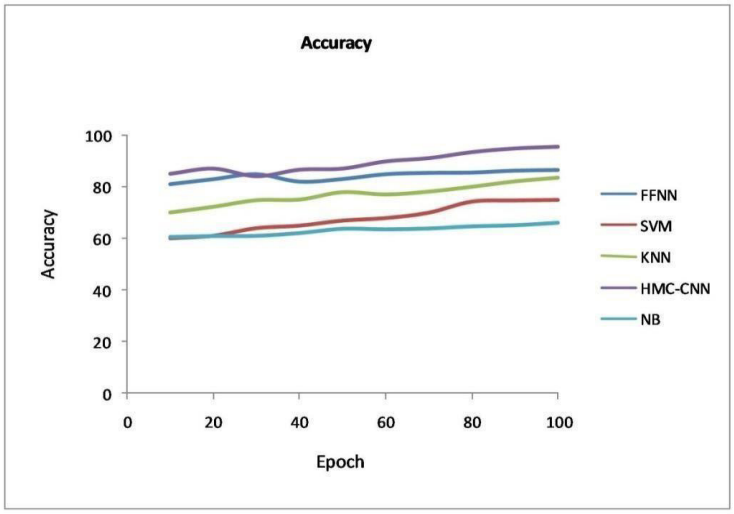

Figure 3. Different accuracy performed by algorithms and MHC-CNN gives the highest accuracy of 93,75 at 100 epochs

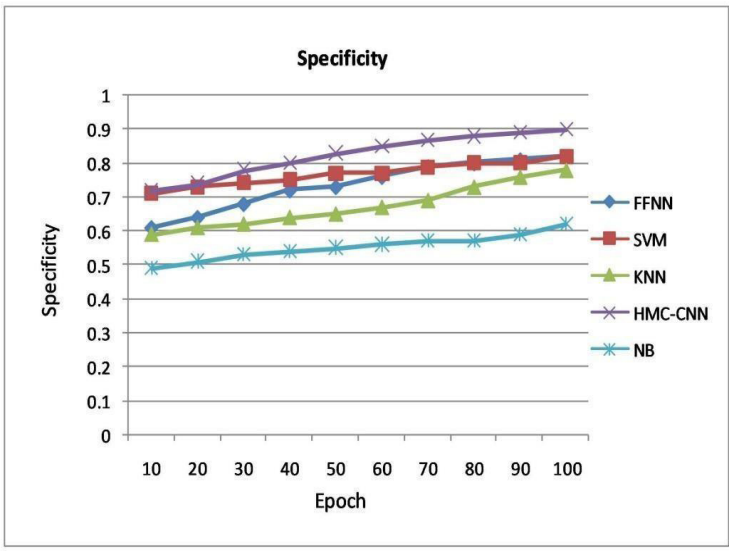

Figure 4. Specificity performance graph

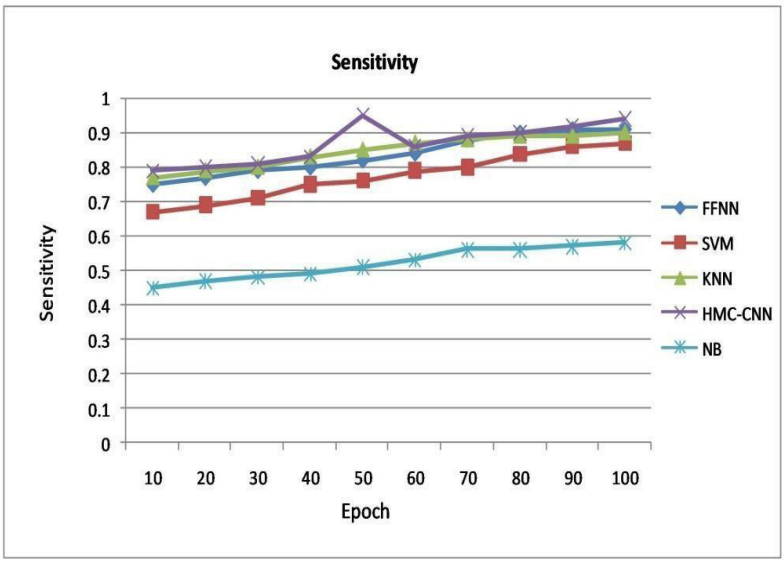

Figure 5. comparison of different Sensitivity performance

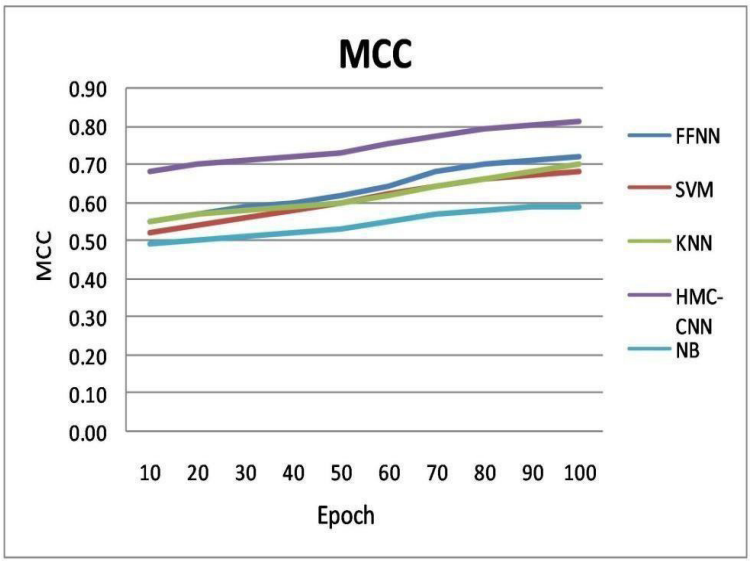

Figure 6. Comparison of different MCC performance

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Accuracy, Specificity Sensitivity, and MCC plots clearly show the performance of mannequins used to predict staff and guest chemical hardness.

DISCUSSION

The current study collects questionnaire data from various hotel employees and guests. The questionnaire included all kinds of questions about hotel location, staff, working hours, health, chemicals, etc. The literature shows, the importance of hotels and how the staff and guests are always affected by various chemicals that are used in various areas. Also, literature tells about the importance of technology like machine learning and Artificial intelligence. To that end, the purpose of this investigation was to use a machine learning model to predict the chemical harmfulness of employees and guests. Table 3 shows that MHC-CNN performed well with a relatively high accuracy of 93,75 %, establishing comparative sensitivity alongside specificity common classifiers (SVM, FFNN, NB, and KNN). It indicates that there is MHC-CNN is highly reliable and is used to predict the harshness of chemicals to staff and guests. The study's built model will demonstrate the percentage of harmfulness of chemicals on staff as well as on guests. The benefit of this model will reduce the health hardness of the chemicals. The framework can be expanded to include more personnel and visitors in the future. Additionally, by collecting data from different regions of the country, we can further improve our ability to predict the chemical harshness of our employees and guests. Collecting more data can further improve the accuracy, specificity, and sensitivity of the model.

CONCLUSION

The study proposed a novel algorithm MHC-CNN for predicting the hardness of chemicals on staff and guests. A “hotel” dataset was also proposed for the study. The dataset consists of information related to geographical features, health background features, hotel domestic features, personal features, chemical perspective, and job-related features that are useful for the study. The proposed algorithm works in two steps: converting the text data to its repeating numeral form followed by the classification by a deep learning architecture. The results have shown that MHC-CNN outperformed all other state-of-the-art ML models achieving the best accuracy, specificity, and sensitivity. In the future, MHC-CNN accuracy can be further enhanced by more data acquisition from different regions of the country. Furthermore, the robustness of the proposed algorithm enables the less use of chemicals for staff persons as well as the guest, around the world.

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FINANCING

The authors did not receive financing for the development of this research.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Acquisition of funds: No.
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