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Review of Biomedical West Identification and Management Techniques

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Abstract: *As we know demand for health facilities are growing day by day. In this last two years because of CORONA COVID 19 pandemic importance of medical field is also get increased. Usages of medicine, masks, biomedical chemicals, and medical equipment's also get increased. But ultimately at the end of day we are using this all facilities and creating too much biomedical west. As we know this biomedical west is very dangerous to the atmosphere and it not get decomposed properly. Collecting this biomedical west by using manual operation can contaminate labours with dangerous diseases. As we know COVID19 is infectious disease, if we come closer to this biomedical west whichis generated during COVID 19 patients' treatment. Then the risk of getting contaminated by this virous is high. To eliminate this type of risks we have to identify biomedical west in first step where human intervention is not necessary. Number of researchers and engineers dose a nicest work in this same field. In this article we are going to review their work and we are going to discussed various factors, biomedical west identification techniques and their importance. We are going to review various biomedical west identification techniques like, image processing technique for biomedical west identification, deep learning, machine learning, Computer learning and CNN for biomedical west identification.*

Keywords: Medical Waste, Computer Vision, Machine Learning, Deep Learning, Waste Classification, image processing, CNN

I. INTRODUCTION

As the demand for health grows, the increase in medical waste generation is gradually outstripping the load. Proper disposal of medical waste is of utmost importance as hospitals and medical centres across the globe are producers of extremely dangerous waste materials. To solve this problem, computer vision based automatic medical waste classification using machine learning and deep learning approach. Thus, this system aims to eliminate the need for manual labour to segregate hazardous medical waste and avoids harmful exposure to contaminated waste.At present, the country has comprehensively carried outgarbage classification. The garbage classification plays averyimportant role in garbage recycling. However, many residents lackclassification knowledge and lack of classification awareness. Theclassification effect is not significant. If not classified, it will notonly cause waste of reusable resources, and for hazardous wastesuch as biomedical west, if not properly handled, it will causeenvironmental pollution and endanger people's health.In the early days, manual sorting or sensors were often used foridentification. Later, it was proposed to identify images based onexisting models and then complete garbage classification throughpre-completed labels or re-collect data sets to train a new garbageclassification model. For existing models, the recognition results ofthe same kind of objects may be different, and the classificationmethod is also different from garbage classification. In practicalapplications, most of the data does not have labels. Labelling dataand building a complete model for classification are required witha lot of time and workload. Image classification has very highrequirements on data set and model performance. These twomethods not only take a lot of time, but also have low accuracy.An electronic copy can bedownloaded from the website.Medical waste (MW) refers to directly or indirectly infectious, toxic, or otherwise hazardous waste generated by medical institutions during medical or preventative care and related activities, and specifically includes infectious, pathological, damaging, pharmaceutical, and chemical waste1. These wastes contain a large number of bacteria and viruses, and have the potential to cause space pollution, acute viral infection, and latent infection

If they are not properly managed, they can contaminate the surrounding environment, where they pollute the land, water, plants, animals, and air, causing the spread of disease. MW also poses a great threat to the physical and mental health and the quality of life of medical staff and patients3. Currently, MW in China is generally collected and processed centrally by a unified acquisition department, and faces challenges such as inadequate use of waste bins, lack of detailed classification of medical waste or even stacking randomly, and insufficient training of waste classification personnel4. High expenses are also one of the reasons for improper disposal of medical waste. Because more processing costs have to be paid to external agencies, the cost of medical waste disposal for hospitals has risen accordingly. The increase in expenditure has caused hospitals to deploy waste disposal facilities and human resources more casually, and in turn, hospitals' medical waste disposal has steeply declined in quality, which greatly increases the potential for medical waste to contaminate the environment and harm the associated staffs, while reducing the chances of its recycling.In the new edition of the National Hazardous Waste List, which was implemented on August 1, 2016 in China, clinical medical waste is regarded as No. 1 Hazardous substance. For disposable medical supplies and drug packaging, non-infectious waste should be disposed of as domestic waste. For disposable syringe nipples and transfusion pipes, waste should be disposed of harmlessly before discarding. For disposable syringes, transfusion needles, blood collection needles and other blood-contaminated waste, in order to prevent medical personnel from occupational exposure and infection must be directly put into instrument collection box. However, this classification method cannot distinguish between recyclable and non-recyclable medical waste, and still involves manual sorting. Therefore, medical personnel involved in sorting cannot completely avoid the risk of virus infection. In recent years, in order to solve the problem of secondary infection of medical waste virus, the government has started to focus on the study of automatic waste classification system. In 2016, bhimanyu Singh and his team proposed a waste collection system based on infrared sensors, which collects real-time waste data through infrared sensors and transmits the information to waste managers in real time so that waste managers can effectively use the information to optimize the collection process. This method optimizes the waste treatment process to a certain extent, but it cannot accurately classify waste. It can only identify the types of waste by the parameters of waste volume, cross-sectional area and transmittance. In 2018, Misra and his team proposed an intelligent waste bin based on ultrasonic liquid level sensors and various gas sensors to automatically detect harmful gases and wastes to the maximum extent, and combined with the Internet of Things technology to achieve a mobile platform for comprehensive monitoring of waste volume and odour. This method improves the process of waste disposal through olfactory detection, but it cannot classify the types of waste accurately. Most of the global waste classification systems only can classify domestic waste, and there is no solution for medical waste that needs to be classified and treated immediately because of the risk of virus infection.Even now, in numerous parts of India, garbage segregation is done by rag pickers. This can prove to be extremely harmful as medical waste is a carrier of infectious germs and radioactive substances which can gravely harm a person's life and in some cases, it could also be the reason for the spread of infectious diseases. In a country like India, due to the fact that a large amount of our population cannot afford proper treatment at well-equipped private hospitals, the majority of the medical facilities are government organisations and are usually incapable of according industrialised automatic garbage segregation machines and often employ manual labour for this job.

II. LITERATURE REVIEW

Related Work

H. Abdu et.al. survey contributes by reviewing various image classification and object detection models, and their applications in waste detection and classification problems, providing an analysis of waste detection and classification techniques with precise and organized representation and compiling over twenty benchmarked trash datasets. Also, we backed up the study with the challenges of existing methods and the future potential in this field. This will give researchers in this area a solid background and knowledge of the state-of-the-art deep learning models and insight into the research areas that can still be explored.

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Xia W et.al. summarizes the application of ML algorithms in the whole process of MSWM, from waste generation to collection and transportation, to final disposal. Through this comprehensive review, the gaps and future directions of ML application in MSWM are discussed, providing theoretical and practical guidance for follow-up related research.

Md. Wahidur Rahman et.al. proposed architecture of the waste management system based on deep learning and IoT. The proposed model renders an astute way to sort digestible and indigestible waste using a convolutional neural network (CNN), a popular deep learning paradigm. The scheme also introduces an architectural design of a smart trash bin that utilizes a microcontroller with multiple sensors. The proposed method employs IoT and Bluetooth connectivity for data monitoring. IoT enables control of real-time data from anywhere while Bluetooth aids short-range data monitoring through an android application.

Yinghao Chu et.al. proposes a multilayer hybrid deep-learning system (MHS) to automatically sort waste disposed of by individuals in the urban public area. This system deploys a high-resolution camera to capture waste image and sensors to detect other useful feature information. The MHS uses a CNN-based algorithm to extract image features and a multilayer perceptrons (MLP) method to consolidate image features and other feature information to classify wastes as recyclable or the others. The MHS is trained and validated against the manually labelled items, achieving overall classification accuracy higher than 90% under two different testing scenarios, which significantly outperforms a reference CNN-based method relying on image-only inputs.

Haiying Zhou et.al. propose a deep learning approach for identification and classification of medical waste. Deep learning is currently the most popular technique in image classification, but its need for large amounts of data limits its usage. In this scenario, we propose a deep learning-based classification method, in which ResNeXt is a suitable deep neural network for practical implementation, followed by transfer learning methods to improve classification results. We pay special attention to the problem of medical waste classification, which needs to be solved urgently in the current environmental protection context. We applied the technique to 3480 images and succeeded in correctly identifying 8 kinds of medical waste with an accuracy of 97.2%; the average F1-score of five-fold cross-validation was 97.2%. This study provided a deep learning-based method for automatic detection and classification of 8 kinds of medical waste with high accuracy and average precision.

X. Bian et.al. designed a medical waste automatic identification and classification system, which adopt technology of machine vision and deep learning algorithm. The system firstly detects and locates medical waste by cross-platform computer vision library (Open CV), then applies SSD-Mobile Net model to train and classify medical waste. The existing background subtraction algorithm and SSD-MobileNet model structure are improved. Examples of haemostatic forceps, gloves, infusion bags and syringes are tested. Experimental results show that recognition accuracy of medical waste classification system is more than 98.5%, and average recognition time is 52 milliseconds, and the system has strong robustness. The application of the proposed method in actual medical waste classification is of great significance in reducing manual input and reducing the risk of virus infection for medical personnel involved in sorting.

J. Chen et.al. propose a system named I WASTE to detect and classify medical waste based on videos recorded by a camera-equipped waste container. In this pilot study, we collected a video dataset of 4 waste items (gloves, hairnet, mask, and shoe cover) and designed a motion detection based pre-processing method to extract and trim useful frames. We propose a novel architecture named R3D+C2D to classify waste videos by combining features learnt by 2D convolutional and 3D convolutional neural networks. The proposed method obtained a promising result (79.99% accuracy) on our challenging dataset. Clinical Relevance—I Waste enables consistent and effective real-time monitoring of solid waste generation in operating rooms, which can be used to enforce medical waste sorting policies and to identify waste reduction strategies.

Guo, D. et.al. applied the ResNet-50 convolutional neural network based on the transfer learning method to design the image classifier to obtain the domestic refuse classification with high accuracy. By comparing the method designed in this paper with back propagation neural network and convolutional neural network, it is concluded that the CNN based on transfer learning method applied in this paper with higher accuracy rate and lower false detection rate. Further, under the shortage situation of data samples, the method with transfer learning and ResNet-50 training model is effective to improve the accuracy of image classification.

A. Sharma et.al. proposed Architecture for Waste Management in Indian Smart Cities (AWMINS). This uses smart bins for garbage classification and collection. The smart bins are fitted with sensors and other necessary hardware

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equipment. These are then integrated with the IoT environment for efficient waste management thereby reducing the wastage of the city's resources.

Ninad Mehendaleet.al. aimed to build an automatic computer vision based medical waste separator that detects the presence of medical waste and categorizes them into one of the four categories namely gloves, mask, syringe and cotton. This embedded system uses transfer learning on the AlexNet deep learning network to train a model which classifies medical waste. The hardware set up is designed to detect the movement of the lid of the input bin and then capture an image of the waste object dropped into the bin. This image is then fed to our trained model which classifies the object with a 86.17\% validation accuracy. Once the model classifies it, the waste object is dropped into the correct bin with the help of servo motors. This embedded system has been tested with different types of gloves, mask, syringe and cotton samples and presents a convenient way to segregate medical waste successfully. Thus, this system aims to eliminate the need for manual labour to segregate hazardous medical waste and avoids harmful exposure to contaminated waste.

S M Cheena et.al. propose a real-time smart waste management and classification mechanism using a cutting-edge approach (SWMACM-CA). It uses the Internet of Things (IoT), deep learning (DL), and cutting-edge techniques to classify and segregate waste items in a dump area. Moreover, we propose a waste grid segmentation mechanism, which maps the pile at the waste yard into grid-like segments. A camera captures the waste yard image and sends it to an edge node to create a waste grid. The grid cell image segments act as a test image for trained deep learning, which can make a particular waste item prediction. The deep-learning algorithm used for this specific project is Visual Geometry Group with 16 layers (VGG16). The model is trained on a cloud server deployed at the edge node to minimize overall latency. By adopting hybrid and decentralized computing models, we can reduce the delay factor and efficiently use computational resources. The overall accuracy of the trained algorithm is over 90%, which is quite effective. Therefore, our proposed (SWMACM-CA) system provides more accurate results than existing state-of-the-art solutions, which is the core objective of this work.

D. Hua et.al. experimented with Keras, to create a convolutional neural network, and OpenCV, to create real-time videos, that identifies hazardous waste from other recyclable materials. Through the use of machine learning, our model is able to categorize different recyclable materials with about 90% accuracy. Objects within the video receive a prediction for 3 classifications which includes batteries, syringes, and nonhazardous waste. Then, the category with the highest category is what the network will classify it as. In conclusion, the model is able to identify hazardous objects and recyclable items within a pile of trash to help protect all individuals.

Limitations of Existing System

Nowadays, clinical medical waste is regarded as No. 1 Hazardous substance. For disposable medical supplies and drug packaging, non-infectious waste should be disposed of as domestic waste. For disposable syringe nipples and transfusion pipes, waste should be disposed of harmlessly before discarding. For disposable syringes, transfusion needles, blood collection needles and other blood-contaminated waste, in order to prevent medical personnel from occupational exposure and infection must be directly put into instrument collection box. However, this classification method cannot distinguish between recyclable and non-recyclable medical waste, and still involves manual sorting. Therefore, medical personnel involved in sorting cannot completely avoid the risk of virus infection. In recent years, in order to solve the problem of secondary infection of medical waste virus, various researchers have implemented automatic waste classification system. The most of the authors detect the waste based on sensors, but it is unable to detect the waste properly, its classified into dry and wet. Also, some authors have implemented waste classification based on general waste or specific medical waste into particular items. So, considering these limitations, we will implement automatic classification of medical waste-based machine learning which effectively classify the waste into several types or degradable or non-degradable.

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III. BASIC BLOCK DIAGRAM FOR MAXIMUM BIOMEDICAL WEST CLASSIFICATION AND IDENTIFICATION

The proposed system architecture of automatic classification of waste is as shown in figure. 1

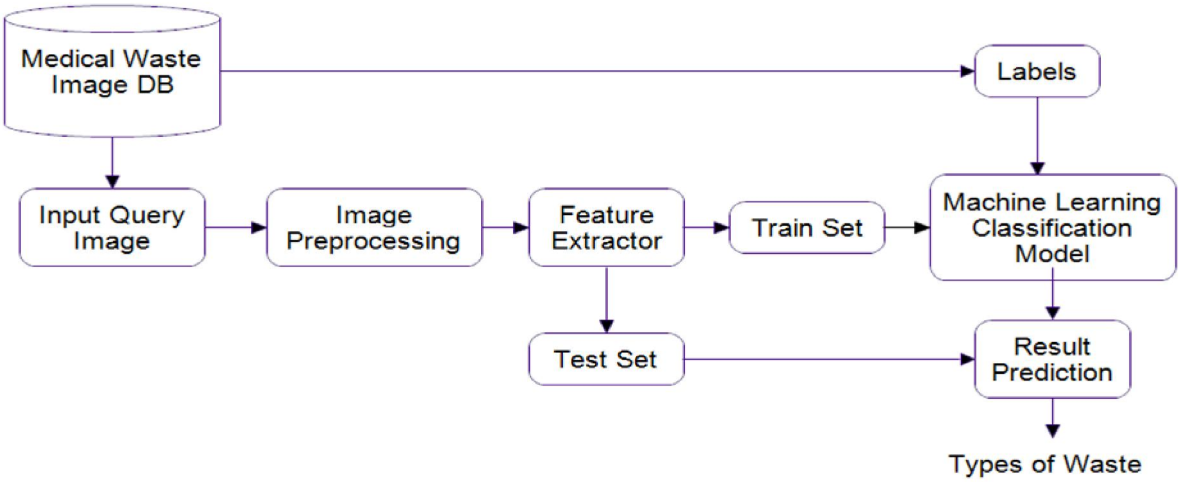

Figure 1: Proposed Block Diagram

Medical Waste Image DB

We are applying our methodology to standard benchmark image database, publicly available dataset, is applied and observed under several aspects. The dataset has a collection of several medical waste images. For experimental evaluation, we will split the dataset into 70-30% ratio for training and testing set of images.

Image Pre-processing

The input images are provided as input to the presented model. In the initial stage, the pre-processing takes place by the use of image resizing as per the size of trained model.

Feature Extraction

At the next stage, a collection of important features gets extracted from the segmented image using pre-trained deep learning model. The pre-trained deep learning model that used is Resnet101 which is based on a convolutional neural network that is 101 layers deep. We chose this model because of its high classification performance.

Classification

Then, the classification of images carried out using machine learning classification model which finally provides the output as classified image into types of medical waste or degradable or non-degradable waste. In our case, we use random forest classifier. Training and testing of computer aided diagnosis models for classifying medical waste performed in proposed approach. The process of extracting features takes place using image processing and classifier operation is carried out utilizing machine learning which helps to develop the trained prediction approaches from the filtered features in an easier way and rapid way.

Various approaches mainly categorized into two phases: Training and Testing. First, retinal fundus image dataset needs to split for two phases in 70-30% ratio of total dataset in train and test image set. In training phase, first train image set need to be processed before feature extraction in which noise removal, image enhancement and image resizing operation is carried out. In feature extraction we are going to extract the low level to high level features using automated feature extraction technique using pre-trained deep convolutional neural network. Later input and output data is collected as feature dataset from train image set and labels from its equivalent train image set respectively. Same data is given to train and validate the machine learning model, in which we have used classifier. After successful validation, we save the trained model. In testing phase, test image set need to apply same operation upto feature extraction as in training phase. After getting test feature set, we load the trained model and predict the results of medical waste image.

IV. CONCLUSION

As we know biomedical west is very dangerous and west management of biomedical garbage is very necessary to protect environment. Manual collection of this hazardous biomedical west can cause various contamination diseases to labors. To protect them from this dangerous situation numbers of researchers dose a work in garbage and biomedical west identification techniques. In this article we have studied about various techniques of biomedical west identification. According to this review of various techniques we can conclude that the necessity of biomedical west identification and classification is very important to improve manual garbage collection system.

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