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Automated Segregation of Bio-Medical Waste

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Abstract : Biomedical waste (BMW) generated in our nation on a day-to-day basis is immense and contains infectious and hazardous materials. According to the survey of the "Central Pollution Control Board", the bio-medical waste generated are about 56,000 tons per year and around 5.2 million people die every year due to mismanagement and improper disposal of bio-medical waste. It is crucial on the part of the employees to know the hazards of the biomedical waste in the work environment and make its disposition effective and in a scientific manner. This proposed work consists of an idea of classifying the bio-medical waste through automated dustbin without involving the man power. It is proposed with roboflow for training the dataset and implemented with the latest yolov7 model which is an object detection algorithm that divides images into a grid system. The automated dustbin is used at the initial stage to segregate the BMW based on the color code. The model will be compact and saves huge time with greater accuracy.

***IndexTerms* - Bio-medical waste, hazards, Yolov7, object detection algorithm, automated bin**

I. Introduction

INTRODUCTION

Due to rapid increase in urbanization, we see a lot of destruction in nature as well as in human lifestyle. Many people have been affected through this migration either physically or mentally, as a result they end up in hospitals. When the need for hospitals increases, it increases the waste deposits in biological laboratory, Operation Theater, clinics, scan centers and pet sanctuary. Health care waste is a unique category of waste by the quality of its composition, source of generation, its hazardous nature and the need for appropriate protection during handling, treatment and disposal. Mismanagement of the waste affects not only the generators, operators but also the common people too. These wastes can be of any form such as solid, liquid, radio-active waves, containers intermediate products and so on.

Bio-medical Waste

Biomedical waste (BMW) is any waste produced during the diagnosis, treatment, or immunization of human or animal research activities pertaining thereto or in the production or testing of biological or in health camps. It follows the cradle to grave approach which is characterization, quantification, segregation, storage, transport, and treatment of BMW. The basic principle of good BMW practice is based on the concept of 3Rs, namely, reduce, recycle, and reuse. The best BMW management (BMWM) methods aim at avoiding generation of waste or recovering as much as waste as possible, rather than disposing.

Therefore, the various methods of BMW disposal, according to their desirability, are prevent, reduce, reuse, recycle, recover, treat, and lastly dispose. Hence, the waste should be tackled at source rather than “end of pipe approach.

BMW treatment and disposal facility means any facility wherein treatment, disposal of BMW or processes incidental to such treatment and disposal is carried out.

There are generally 4 different kinds of medical waste:

- infectious
- hazardous
- radioactive
- general.

Infectious waste

This can include human/animal tissue, blood-soaked bandages, surgical gloves, cultures, stocks, or swabs that were used to inoculate cultures. Some infectious waste can even be labeled as pathological, which is any waste that could contain pathogens.

Hazardous waste

This can include things like chemicals (medical and industrial), old drugs, and sharps (needles, scalpels, lancets, etc.). Hazardous waste needs to be treated seriously and should be dealt with by an experienced Maryland waste removal company.

Radioactive waste

Radioactive waste is produced from nuclear medicine treatments, cancer therapies and medical equipment that uses radioactive isotopes. Any pathological waste that is also contaminated with radioactive material is usually treated as radioactive waste. Radiation carries with it a number of potential health risks and should only be removed by a professional Maryland medical waste removal company

General waste

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

RELATED WORKS

Recent years have witnessed remarkable progresses in the technology of computer vision, with a variety of approaches propose in the literatures and applied in the real applications relevant to garbage classification. The below researches mainly focus on one particular kind of garbage, using computer version to classify or clean specific garbage. [1] Yanhong He had displaced the standard convolution by depth-wise separable convolution in order to give greater accuracy.

[2]Kashif Ahmad had employed and compare six different fusion methods including two feature-level fusion schemes, namely (i) Discriminant Correlation Analysis and (ii) simple concatenation of deep features, and four late fusion methods, namely (i) Particle Swarm Optimization, (ii) Genetic modeling of deep features (iii) Induced Ordered Weighted Averaging and (iv) a baseline method where all the deep models are treated equally. [5] Nicholas Chieng Anak Sallang had develop a smart waste management system using the deep learning model that improves the waste segregation process and enables monitoring of bin status in an IoT environment. The SSD MobileNetV2 Quantized is used and trained with the dataset that consists of paper, cardboard, glass, metal, and plastic for waste classification and categorization. By integrating the trained model on TensorFlow Lite and Raspberry Pi 4,[8] the camera module detects the waste and the servo motor, connected to a plastic board, categorizes the waste into the respective waste compartment.

However, bio-medical waste classification often suffers from poor efficiency and low reused rate also because of the unexpected mixing of different kinds of garbage during the waste transportation process. So, realizing the supervision of waste transportation process to prevent the happening of it is crucial to improve the effect of garbage classification.

SIGNIFICANCE OF THE METHOD

A.Existing system

There are plenty of algorithms used in garbage classification [1] this paper is an approach to supervise the waste transportation process based on novel YOLOv3 network, motivate by the endeavours of the solutions proposed to supervise the transportation process as well as other studies related to computer vision. It uses depth-wise convolution to displace the original standard convolution, which could decrease the size of model and the detection time. [2] The system id proposed to fuse multiple deep models, exploring the capabilities of several early and late fusion techniques both individually and jointly combined in a novel double fusion scheme where the contributions of early and late fusion methods are combined in an optimal way for image-based waste classification task. In details, the capabilities of the deep models are firstly combined in several ways including two early fusion strategies, namely Discriminant Correlation Analysis (DCA) and simple concatenation of deep features, and four late fusion methods, namely Particle Swarm Optimization (PSO), Genetic Algorithms (GA), Induced Ordered Weighted Averaging (IOWA) based Fusion and simple averaging of classification scores obtained with classifiers trained on features extracted via different deep models. However all the waste classification is done at the later stage. In between there are many life losses and injuries to the employees handling the wastes.

B. Proposed System

In order to overcome human losses and injuries, the main aim of the proposed system is to segregate at the initial step. The proposed system is an automated bin that segregates the object based on the color code , that is black – all sharps, red – plastic products, blue – Glass products and yellow – for cotton, tissues and organs. The proposed system is used at the laboratories, clinics and operation theatre etc…

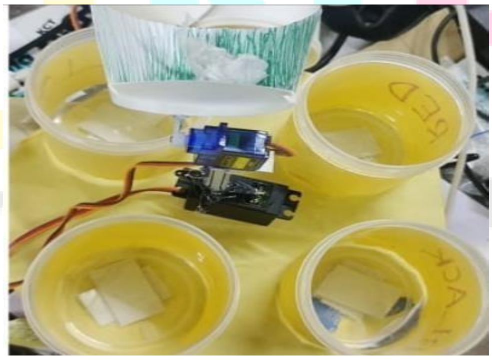


Fig.1 Prototype

It uses the YOLOv7 algorithm for better accuracy,The rise of object detection algorithms has relied on the development of deep learning and arithmetic power. In the early stage of deep learning development, the limitation of arithmetic power led to neural networks that could not be too large. When the problem of arithmetic power was solved by the introduction of professional graphics cards for deep learning by NVIDIA and other graphics card companies, the problem of overfitting, which be caused by networks that are too deep, and a series of problems such as gradient disappearance and gradient explosion, which can be triggered by decreasing the number of features obtained by lower-layer networks, arose.

YOLOv7 was created by WongKinYiu and AlexeyAB, the creators of YOLOv4 Darknet (and the official canonical maintainers of the YOLO lineage according to pjreddie, the original inventor and maintainer of the YOLO architecture). You can read the YOLOv7 paper or take a look at our quick 5 minute breakdown of what's new in Yolov7.

The model itself is impressive. Built with PyTorch, it boasts state-of-the-art performance on MS COCO for real-time object detection models (defined as running 5 FPS or faster on a V100 GPU). The various sizes of the model run at between 36 and 161 frames per second (with a batch size of one), which is extremely impressive given the high accuracy.
A number of new changes were made for YOLOv7.Now we will attempt to breakdown these changes, and show how these improvements lead to the massive boost in performance in YOLOv7 compared to predecessor models.

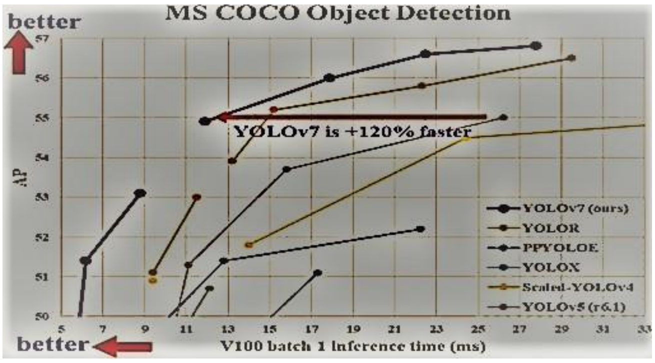


Fig 2. YOLO Comparision

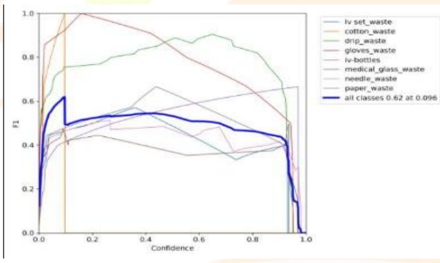
C.Extended efficient layer aggregation networks

Model re-paramaterization is the practice of merging multiple computational models at the inference stage in order to accelerate inference time. In YOLOv7, the technique "Extended efficient layer aggregation networks" or E-ELAN is used to perform this feat.

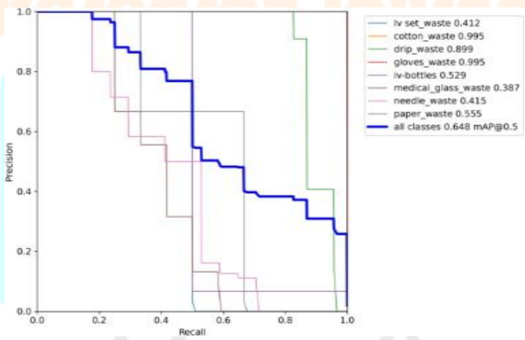
D.Coarse for the auxiliary heads, and fine for the lead loss head

Deep supervision a technique that adds an extra auxiliary head in the middle layers of the network, and uses the shallow network weights with assistant loss as the guide. This technique is useful for making improvements even in situations where model weights typically converge. In the YOLOv7 architecture, the head responsible for the final output is called the lead head, and the head used to assist in training is called the auxiliary head. YOLOv7 uses the lead head prediction as guidance to generate coarse-to-fine hierarchical labels, which are used for auxiliary head and lead head learning, respectively.

RESULT



Confusion Matrix Visualization



Result

PR Curve Visualization

CONCLUSION

This paper is inspired by the detector network and improves the upon the YOLOv7 network. During the preliminary data collection process, We have personally went to many hospitals to know what are the difficulties faced by the workers and doctors during the waste disposal, made automated dustbin that classifies the bio-medical waste based on the colour code in the initial stage to reduce the work load of the workers and the disease caused by them. After the working and necessity of the model, we may work it on a large scale and at multi-environment.

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