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Article	Year	Proposition	Working principle	Data context	Implementation state	Sensors	Additionally functionalities	Processing place	Number categories	Separation categories	Dataset	Evaluation method	Performance metrics	Waste treatment or requirements	Challenges and future work
wang_smart_2021	2021	Device open the recycling category lid based on a photo taken by the user with his/her phone.	Vision + Human.	Institutional, household	Laboratory	Phone camera, ultrasonic wave sensor, gas sensor	Bin level, abnormal gases, web platform	Cloud	6	plastic, glass, paper or cardboard, metal, fabric and other recyclable waste	wang_smart_2021	Evaluation on the vision model with 30% random selected portion of the dataset	Average Acc: 94.44%. Confusion matrix. macro-precision (94.37%), macro-recall (94.04%), macro-F1- score (94.19%) macro-ROC-AUC (99.41%)	One waste per classification. Internet connection. User with mobile device	Multiple waste detection on single image. Image segmentation
kapadia_dry_2021	2021	High speed system that uses machine vision and pneumatic blast for automatic waste segregation	3D waste is dumped into a vibration feeder. Vibration transfer object by object to conveyor belt. Waste is classified by the vision model and later a pneumatic blast throw thew object to the corresponding bin	Municipal	With context	RGB camera, proximity sensor	-	Local computer (7th gen Intel i5 processor, 8GB DDR4 RAM,2GB NVIDIA	3	Plastic bottles, metal cans, and tetra packs	kapadia_dry_2021	Evaluation of the vision model with balanced subset of the dataset with 300 images	Average Acc: 96% Confusion matrix. Precision per class Recall per class. Sorting speed rate: 200-250 objects per minute	3D Waste	Objects with the same brand and different material are miss-classified by the model
md_intelligent_2021	2021	Automatic sorting bin prototype of recyclable municipal solid waste	Composed of 2 parts, Identification: use a webcam connected to a laptop to identify the object. Collector receive the signal to open a camber with a servomotor according to the object identified	Municipal	Laboratory	Webcam	-	Local (Laptop)	2	Pet bottles, LDPE chips packages	md_intelligent_2021	Prototype testing: 100 scenario test have been performed by taking picture with the webcam with similar conditions to the training dataset	Average accuracy: 84 % Total true-positive data: 84, Total false-positive data: 16	One waste per classification	Relatively smaller data set training is one of the limitation of the proposed model
rahman_intelligent_2020	2020	Design architecture of a waste management system based on deep learning and IoT	The waste is placen on a roller band, a camera takes the image of the waste and is processed on a Raspberry PI, send a command to the roller band and to a servo motor to place the object in the correct trash	Household	Laboratory	Webcam, ultrasonic sensor	Bin level, mobile application	Local (Microcontroller ESP8266)	6	Organic (cardboard, glass, metal, paper, and plastic.), Inorganic (trash)	Trashnet	Evaluation of the visual model: Two data division were used: - 80% training data, 10% validation data, and 10% testing data. - 50% training data, 25% validation data, and 25% testing data. Evaluation of ultrasonic sensor: response time per load. System Usability Scale to check the regular user's satisfaction	Average Accuracy: 95.3% Accuracy per class Confusion matrix Sensors delay time per load SUS score of 86%	One waste per classification	Few categories of inorganic waste. The level detection is affected by uniformity of the trash. Enrich with more functionalities such as gas detection
maulana_design_2018	2018	A prototype of waste management system has been developed for the solid waste segregation and garbage collection phase.	the type of waste based on RFID Tags that exist on the packaging of the product.	Institutional, Household	Laboratory	Ultrasonic, capacitive, inductive sensors	Managing trash device data, knowing garbage statistics, managing administrator data, views garbage data report, and views the location of near-fully loaded trash bin.	Local (Raspberry Pi)	3	paper or cardboard, glass, and plastic waste	-	Test case of the different system functionalities (binary)	Results by each test case	One waste per classification. Waste has to be positioned correctly on the sensors array	communication delay, response time, and the accurate placement of the objects to be detected. improving the quality of hardware used so that the readings of the sensor can be more accurate and data processing can be done more quick
mahat_automatic_2018	2018	design a system to separate the metal recyclable household waste automatically and record the data waste collected	The waste pass by a conveyor belt and identification is performed by the properties of each waste: 1. Inductive sensor: metals. 2. Bar magnet: steel, 3 Color sensor: copper, finally inductive sensor check agin if aluminum	Household	Laboratory	Inductive sensor, color sensor, bar magnet, ultrasonic sensor	-	Local (Arduino)	4	non-metal, steel metal, copper metal, aluminum metal.	-	The experiment has been done to test the machine effectiveness. Each material was placed on the machine one piece at a time to be tested. The proposed prototype succeeds to differentiate metal waste.	Classification time: 14.5s per piece. Distance to detect metals: 5mm-7mm	One waste per classification	-
kim_designing_2021	2021	proposed a three-step optimization process of a reverse vending machine categorized recyclable wastes as plastics, glass, and cans using barcode, vision, and near infrared sensors	The first step involved primary sorting to separate the wastes as plastics, cans, and glass by scanning the barcode of the waste products using a camera sensor	Institutional	Laboratory	RGB Camera, NIR sensor	-	Local	8	Plastic (PET, PS, PE, PP), can, glass (Color green, color dark)	Database of local bar codes	Efficiency of bar code classification horizontal and vertical, classification by color, NIR sensor Efficiency is measured as Worrell-Stessel efficiency (Yuan et al. 2015)	Bar code efficiency (horizontal): 58% Bar code efficiency (vertical): 100% Color classification efficiency: 100% (<270mm) NIR efficiency: 100% (100ms)	One waste per classification	-
midi_recyclable_2019	2019	A system that uses weight and ultrasonic sensor to categorize automatically waste	The object weight and dimension are measured and is classified by looking in a database	Household	Laboratory	weight, ultrasonic sensor	-	Local (Arduino)	4	paper, glass, plastic, metal	Dimension and weights on 10 household items	The accuracy of the system was checked by running an accuracy test for each of the item chosen. Here, each item were tested ten times	Accuracy by item	One waste per classification. Object is required to be in the database	The requirement of a database for all the items. Improvements on the hardware. Include more sensors. Add IOT
chandramohan_automated_2017	2017	This paper proposes an Automated Waste Segregator (AWS) which is a cheap, It is designed to sort the refuse into metallic waste, wet waste and dry waste	Waste is pushed through a flap, An IR proximity sensor detects this and starts. Waste falls on a parallel resonant impedance sensing mechanism to identify metallic items, and then fall on a capacitive sensors to distinguish between wet and dry waste. A circular base is rotated and a collapsible flap is opened	Household	Laboratory	IR proximity sensor, parallel resonant impedance sensor, capacitive sensors	-	Local (Microcontroller)	3	metallic waste, wet waste, dry waste	large volume of the dry waste objects, and a minimum quantity of one object each for wet waste objects.	Evaluate measures of the capacitive an proximity on different household items	Threshold values	One waste per classification	it cannot segregate ceramic into dry waste. improvements can be made to segregate mixed type of waste. the time for sensing metal objects is low
paulraj_automated_2016	2016	Development of a robotic mobile manipulation system for automated sorting of useful recyclables from MSW	A robotic arm on a mobile platform with proximity sensor and thermal camera type of the near object, grab the object and place on the bin	Municipal	Laboratory	thermographic camera, proximity sensor	-	Local	3	aluminum can, plastic bottle, tetra	paulraj_automated_2016	Evaluation of the model: 20% of the dataset	Average Acc: 94.3% Precision, Recall, harmonic-mean per class, Av. Precision: 0.94 Av. Recall: 0.945, Av. Harmonic: 0.94	One waste per classification, simple background,	Improve classification accuracy on complex backgrounds, incorporate wider variety of materials, global path for navigation, developing a grasp planning algorithm to handle various sizes
korucu_investigation_2016	2016	investigate the usability of sound recognition for source separation of packaging wastes in reverse vending machines (RVMs)	Packaging waste sounds generated by three physical impacts such as free falling, pneumatic hitting and hydraulic crushing were separately recorded. Sound features are used to classify waste by a ML model	Municipal	Laboratory	Dynamic microphone, condenser microphone	Mass prediction	Local	4-11	metal (2 sizes), plastic (3 sizes), glass (3 sizes), cardboard (3 sizes)	korucu_investigation_2016	Evaluation of the mode 10% of the dataset	Average Acc: 100% Average Acc type and mass: 88.6%, Acc by model, Acc by microphone	One waste per classification, 3d waste, empty packages	Small dataset, included half empty and full packaging wastes, combinations of sound and image classification approaches
funch_detecting_2021	2021	proof-of-concept method to classify the presence of glass and metal in consumer trash bags using sound recording and a A custom-built test rig	The sound of the trash bags when the bins are empty on the collection truck is recorded and a model is used to classify if there is a presence of metal or glass	Municipal	Laboratory	stereo condenser microphone, contact microphone, weight sensor, RGB camera	-	Local (Arduino)	4	metal and mixed waste, glass and mixed waste, glass and metal, and pure mixed waste	funch_detecting_2021	Evaluation of the model with 20% for validation of dataset, additionally a separate dataset of 40 unique bags (10 for each category)	Av. acc: 98.14%, Av. precision: 99.49%, Av recall: 96.77%. ROC Confusion matrix	One waste per classification, without background noise	collecting more realistic data- sets of consumer trash bags, should be tested in more realistic settings.
zhang_computer_2021	2021	An automatic sorting machine was designed and made to test the performance of the models. It consisted of three main modules: the Computer-Vision Module, the Sorting Module, and the Customized Module	Computer vision module classify waste based a camera picture and send signal to stepper motors to drive the waste to the corresponding bin	Municipal	Laboratory	RGB camera, light sensor	-	Local (Raspberry Pi)	4-13	Recyclable [Fabric, metal, paper, plastic bottle, glass], residual [Cigarette, plastic box, plastic bag, tissue], household food [Expired food, fruit], hazardous [Battery, medicine]	zhang_computer_2021	Evaluation of the model	Av. acc categories: 93.8% Av. acc sub-categories: 94.7%, Acc per category and subcategory, precision, recall, and F1-score per category and subcategory	One waste per classification	the dataset is limited, More varieties of waste
koskinopoulou_robotic_2021	2021	implementation of an autonomous robotic system for the categorization and physical sorting of recyclables according to material types. development of a low-cost computer vision module	Waste is placed on a conveyor belt by a feeder and transported, waste is recognized using images from a camera and a robotic arm with a vacuum gripper place the waste in the bins	Municipal	With context	RGB stereo camera	-	Local	4	Aluminum, paper/ cardboard, PET bottles, nylon	koskinopoulou_robotic_2021	Evaluation of the model with 1000 random real-flow images, evaluation of individual modules	Total system Av. Acc (include robot): 90.2% Total system Acc per class, AP, AR, F1 per class, MAR (Mean av. Recall): 80.1% MAP (Mean av. Precision): 84.2%	-	Current public datasets do not fit industrial waste characteristics (deformation and dirt), Dataset with not enough variability. Precision of the system is lower in real conditions due to uncontrolled dirt on the recyclables. waste exhibits sea- sonal characteristics that can affect management strategies.
chen_garbage_2022	2022	Designs and develops a garbage classification system based on deep learning that can recognize and recycle domestic garbage. Focusing	Garbage is transported in a conveyor belt, passes by a photoelectric sensor which triggers a camera that classify the waste. The waste continue in the conveyor belt and falls into a platform that is inclined to the correct bin	Household	Laboratory	RGB Camera, photoelectric sensor	-	Local (Raspberry Pi)	4-14	Reciclable (towel, spitball, packaging bag, metal, paper box, bottle, book), wet garbage (orange, leaf, banana), hazard (bulb, battery), dry (plastic bag, glass, cullet)	chen_garbage_2022	Evaluation of the model, The system is put through a complete functional test and ten categories of domestic garbage are randomly thrown into the system in turn	Av. Acc: 97.9% Inference time: 105ms, Acc of motor rotation per class,	One waste per classification	In our real life, garbage has different forms and more categories. How to build an effective data collection platform or expand datasets by using adversarial learning. Ensure only a single object is presented by hardware design, Segmentation prediction
ziouzios_intelligent_2022	2022	We propose an automatic system based on CNN with high accuracy, low power and costs for separating the waste materials	Garbage is transported on a conveyor belt images are taken from a camera place on top and detect and category the waste.	Municipal	With context	RGB-IR camera	-	Local (Laptop)	4	Paper, plastic, aluminum, other	ziouzios_intelligent_2022	Evaluation of the model from videos of real scenario	Av. Acc 92.43%, FPS 60, Recall 92%, Mean IOU: 63.58%,	-	location-based custom dataset that we used, it is difficult to directly compare our system to others found in the literature. real-time object detection capabilities of the other tools. The main disadvantage of our model is the hardware cost and energy consumption. A viable alternative for improving the suggested system's execution speed and effi- ciency is to execute the object detection algorithm on an FPGA board
longo_take_2021	2021	prototype of a Smart Waste Bin, a connected trash bin that automatically sorts garbage with the help of Convolutional Neural Networks algorithms	Waste Disposal Unit. A piece of trash is inserted and recognized using a CNN model. The semicircular structure acts as a mechanical arm and moves the trash towards the correct bin	Municipal	Prototype	RGB camera, distance sensor	Web platform, bin level	Local (Raspberry Pi) Cloud	5-39	Glass (Coke, Beer Becks, Aperol Bottle, Heineken Beer Bottle, Jar, Red Beer, Water Bottle), Paper (Business Card, Candy Box, Cup, Flyers, Paper Bag, Juice Box, Magazine, Paper Napkins, Newspaper), Plastic(Blue Bottle, White Bottle, Green Bottle, Coffee Capsule Packet, Transparent Glass, White Dish, Green Dish, Red Dish, Cutlery, Estathè bottle, Fiesta Packet, Yogurt Cup, Bag), Aluminium(Coke Can, Fanta Can, Sprite Can, Redbull Can, Box, Coke Zero Can, Foil, Estathè Can, Jar Lid), unsorted(Backing Paper, Bic Pen, Pen, CD, Cigarettes, Lighter, Marker, Receipt)	longo_take_2021	Model evaluation, Device evaluation with energy and time consumption on classification	Model Av. Acc: 97%	One waste per classification	Controlled test With context, sensor fusion for material properties identification, continuous learning,

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Dataset	Nickname	Year	Categories	Context	Dataset preparation	Studies with dataset	No. Categories	Sub-categories	No. Subcategories	No. Observations	Class per Observation	Public/ Private	Annotation type	Background type	Geographical loc.	Cat. Distribution	Resolution	Sensors	Origin	Link
wang_smart_2021	-	2021	Plastic, glass, paper or cardboard, metal, fabric and other recyclable waste	Municipal/general	-	wang_smart_2021	6	-	-	17.073	Single	Private	Classification	With context	Unknown/ mixed	Unbalanced	Uneven and Unknown	Unknown, Apple iPhone 7 Plus, Apple iPhone 5S, and Apple iPhone SE.	TrashNet amplified	-
kapadia_dry_2021	-	2021	Plastic bottles, metal cans, and tetra packs	Municipal/on-device	-	kapadia_dry_2021	3	-	-	30.000	Single	Private	Classification	Simple	-	Balanced	Even and 600x480	mvBlueFOX MLC-205 GC	Built	-
md_intelligent_2021	-	2021	Pet bottles, LDPE chips packages	Municipal/on-device	-	md_intelligent_2021	2	-	-	~1000	Single	Private	Classification	Simple	Shaheb Bazar, Rajshahi	Unbalanced	Even and 300x300	Webcam	Built	
TrashNet	Trashnet	2017	glass, paper, cardboard, plastic, metal, and trash	Institutional/ general	-	rahman_intelligent_2020, singh_evaluation_2021, mao_deep_2022, zheng_encnn-upmws_2021, melinte_deep_2020, andhy_panca_saputra_waste_2021, aqyuni_waste_2020, vo_novel_2019, liang_deep_2021	6	-	-	2.527	Single	Public	Classification	Simple	-	Unbalanced	512x384, 3264×2448	Apple iPhone 7 Plus, Apple iPhone 5S, and Apple iPhone SE.	Built	https://github.com/garythung/trashnet
paulraj_automated_2016	-	2016	aluminum can, plastic bottle and tetra	Municipal/indoors on floor	-	paulraj_automated_2016	3	-	-	1.500	Single	Private	Classification	Simple	-	Balanced	Even and 320x240	FLIR E40 thermal imaging camera	Built	-
korucu_investigation_2016	-	2016	metal, plastic, glass, cardboard	Municipal/on-device	-	korucu_investigation_2016	4	metal (2 sizes), plastic (3 sizes), glass (3 sizes), cardboard (3 sizes)	11	600	Single	Private	Classification	Simple	Kocaeli, Turkey	Balanced	44,100Hz sampling rate with 16 bits quantization level.	Dynamic microphone (MXL LSM-5GR), condenser microphone (MXL CR89)	Built	-
funch_detecting_2021	-	2021	metal and mixed waste, glass and mixed waste, glass and metal, and pure mixed waste	Municipal/on-device	-	funch_detecting_2021	4	-	-	1.616	Single	Private	Classification	Simple	-	Balanced	Even and Unknown	Stereo condenser microphone (Zoom H6n), contact microphone	Built	-
zhang_computer_2021	-	2021	Recyclable, residual waste, household food, hazardous	Municipal/on-device	Data cleansing	zhang_computer_2021	4	Recyclable [Fabric, metal, paper, plastic bottle, glass], residual [Cigarette, plastic box, plastic bag, tissue], household food [Expired food, fruit], hazardous [Battery, medicine]	13	1.040	Single	Private	Classification	Simple	Shanghai, China,	Unbalanced	Even and Unknown	RGB camera	Built	-
koskinopoulou_robotic_2021	-	2021	Aluminum, paper/cardboard, PET bottles, nylon	Municipal/general	Synthetic data augmentation	koskinopoulou_robotic_2021	4	-	-	16.000	Multiple	Public	Segmentation	Augmented	Crete, Greece	Balanced	Even and 800x800	Zed stereo camera	Built	https://github.com/kskmar/ReSort-IT
chen_garbage_2022	-	2022	Reciclable, wet garbage ,hazard , dry	Household/ general	-	chen_garbage_2022	4	Reciclable (towel, spitball, packaging bag, metal, paper box, bottle, book), wet garbage (orange, leaf, banana), hazard (bulb, battery), dry (plastic bag, glass, cullet)	14	4.256	Single	Private	Classification	With context	Unknow/ mixed	Unbalanced	Uneven and Unknown	RGB camera LRCP1080P	Web	-
mao_deep_2022	TRWD	2022	plastic container, plastic bottle, metal, carton, paper container, and glass.	Municipal/on-device	-	mao_deep_2022	6	-	-	3.706	Multiple		Detection	Simple	Taiwan	-	-	RGB camera	Built	-
lu_deep_2022	-	2022	Ceramic tablewarem empty plastic bottle, empty plastic storage, empty tetrapack, empty tetra pack without straw, glass bottle, glass bottle without the cap, metal button, plastic bottle with the filling, plastic storage mixed with other waste, plastic tableware, resin button	Municipal/on-device	-	lu_deep_2022	12	-	-	4.320	Single	Private	Classification	Simple	-	Balanced	Even and 300x300, 10ms audio	Phone, AudioTechnica microphone	Built	-
song_optimization_2020	-	2020	Recyclable, organic, harmful, residual	Municipal/general	-	song_optimization_2020	4	-	-	5.828	Single	Private	Classification	Simple	-	Unbalanced	512x384	RGB camera	Web, photos, previous works	-
proenca_taco_2020	Taco	2020	Plastic bag & wrapper, Cigarette, Unlabeled litter, Bottle, Bottle cap, Can, Other plastic, Carton, Cup, Straw, Paper, Broken glass, Styrofoam piece, Pop tab, Lid, Plastic container, Aluminum foil, Plastic utensils, Rope & strings, Paper bag, Scrap metal, Food waste, Shoe, Squeezable tube, Blister pack, Glass jar, Plastic glooves, Battery	Municipal/in wild	-	ziouzios_intelligent_2022, lv_garbage_2022, panwar_aquavision_2020 , proenca_taco_2020	28	Cigarette, Unlabeled litter, Plastic film, Clear plastic bottle, Other plastic, Other plastic wrapper, Drink can, Plastic bottle cap, Plastic straw, Broken glass, Styrofoam piece, Disposable plastic cup, Glass bottle, Pop tab, Other carton, Normal paper, Metal bottle cap, Plastic lid, Paper cup, Corrugated carton, Aluminum foil, Single-use carrier bag, Other plastic bottle, Drink carton, Tissues, Crisp packet, Disposable food container, Plastic utensils, Food Can, Garbage bag, Meal carton, Rope & strings, Paper bag, Scrap metal, Foam food container, Foam cup, Magazine paper, Wrapping paper, Egg carton, Aerosol 1, Metal lid 1, Spread tub 1, Food waste 1, Shoe, Squeezable tube, Aluminum blister pack, Glass cup, Other plastic container, Glass jar, Six pack rings, Toilet tube, Paper straw, Plastic glooves, Tupperware, Polypropylene bag, Pizza box, Other plastic cup, Battery, Carded blister pack, Plastified paper bag,	60	1.500	Multiple	Public	Segmentation	With context	Mixed	Unbalanced	Uneven	RGB camera	Web	http://tacodataset.org
ziouzios_intelligent_2022	-	2022	Paper, plastic, aluminum, other	Municipal/on-device	-	ziouzios_intelligent_2022	4	-	-	4.000	Multiple	Private	Detection	With context	Kozani, Greece	Unbalanced	-	RGB camera	Taco + Built	-
cai_research_2020	-	2020	Fishbone, pericarp, tea residue, vegetable leaves, ceramics, cigarette, tableware, trashbag	Household/ general	-	cai_research_2020	8	-	-	2.800	Single	Private	Classification	With context	-	Balanced	-	RGB camera	Web	-
zheng_encnn-upmws_2021	Fourtrash	2021	wet waste, recyclables, harmful waste, and dry waste	Household/ indoors		zheng_encnn-upmws_2021	4	-	-	47.332	Single	Private	Classification	Simple	-	Unbalanced	Uneven	RGB camera	Kaggle:techsash/waste-classification-data + Web	-
caballero_inference_2021	Fotini10k	2021	plastic bottles, aluminum cans, paper and cardboard	Municipal/on-device	-	caballero_inference_2021	3	-	-	10.391	Single	Public	Classification	Simple	-	Balanced	Even and 2592x1944	RGB camera	Built	https://github.com/jaimix4/smart-trash-bin-my-thesis
seredkin_development_2019	-	2019	PET bottle, HDPE bottle, aluminum can, other	Municipal/on-device	-	seredkin_development_2019	4	PET green, PET dark, PET transparent, PET blue, PET teal, PET multicolor	6	13.000	Multiple	Public/no available	Detection	Simple	Novosibirsk, Rusia	Unbalanced	Even and Unknown	RGB camera	Built	-
calvini_developmentof_2018	-	2018	PET, PS, PVC, PP, HDPE, LDPE	Household/on-device	Raw intensity counts were converted into reflectance - units, Background segmentation	calvini_developmentof_2018	6	-	-	22.400	Single	Private	Segmentation	Simple	-	Balanced	NIR [1330nm-1900nm] Resolution 6nm	hyperspectral camera (KUSTA1.9MSI)	Built	-
zhang_multi-label_2022	-	2022	glass, fabric, metal, plastic, paper.	Household/ general	-	zhang_multi-label_2022	5	-	-	1.543	Multiple	Private	Detection	Simple	-	Unbalanced	-	RGB camera	Built	-
zhang_waste_2021	NWNU-TRASH	2021	glass, fabric, metal, plastic, paper.	Household/ general	-	zhang_waste_2021	5	-	-	18.911	Single	Private	Classification	With context	-	Unbalanced	-	RGB camera	Web + Built	-
chen_multi-objective_2021	-	2021	Plastic, Paper, Fabric, Metal, Glass	Municipal/general	-	chen_multi-objective_2021	5	-	-	2.000	Multiple	Private	Detection	Simple	-	Unbalanced	-	RGB camera	Web + Built	-
andhy_panca_saputra_waste_2021	-	2021	glass, metal, paper, and plastic	Municipal/general	-	andhy_panca_saputra_waste_2021	4	-	-	3.870	Multiple	Private	Detection	With context	-	Unbalanced	299x299	RGB camera	Web	-
Kaggle:asdasdasasdas/garbage-classification	-	2019	Cardboard, glass, metal, Paper, Plastic, Thrash	Municipal/indoors	-	duhayyim_deep_2022	6	-	-	2.437	Single	Public	Classification	Simple	-	Unbalanced	512×384	RGB camera	Built	https://www.kaggle.com/datasets/asdasdasasdas/garbage-classification
liang_deep_2021	WasteRL	2021	organic, recyclables, hazardous, other wastes	Municipal/general	Three-step annotation method	liang_deep_2021	4	-	-	57.000	Multiple	Public/on request	Detection	With context	Mixed	Unbalanced	Uneven [224x224 to 1920x1080]	RGB camera	Public datasets	-
vo_novel_2019	VN-trash	2019	Organic, Inorganic and Medical	Municipal/general	-	vo_novel_2019, liang_deep_2021	3	-	-	5.904	Single	Private	Classification	With context	Mixed	Unbalanced	-	RGB camera	Web + photos	-
frost_compostnet_2019	-	2019	trash, recyclable, compostable	Municipal/general	Relabeled	frost_compostnet_2019	3	-	-	2.751	Single	Public	Classification	Simple	Mixed	Unbalanced	-	RGB camera	Trashnet modified	https://github.com/sarahmfrost/compostnet
Kaggle:sapal6/waste-classification-data-v2	-	2020	Recyclable, Non-recyclable, organic	Municipal	-	thanawala_approach_2020	3	-	-	25.000	Single	Public	Classification	With context	-	Unbalanced	-	RGB camera	-	https://www.kaggle.com/datasets/sapal6/waste-classification-data-v2
bobulski_pet_2018	Wadaba	2018	Unreadable identifier, PET, PE-HD, PVC, PE-LD, PP, PS,Other	Municipal/general	-	bobulski_pet_2018, bobulski_deep_2021	8	Color (11), light (2), deformation (4), dirtiness (4), lid (2), ring (2), position (5)	30	4.000	Single	Public	Classification	Simple	Poland	Unbalanced	1920x1277@300dpi	RGB camera	Built	http://wadaba.pcz.pl
hong_trashcan_2020	Trashcan	2020	Crab, eel, animal, fish, shells, starfish, plant, row, bag, bottle, branch, can, clothing, container, cup, net, pipe, rope, wrapper, hard, unknown, wreckage	Municipal/ underwater	-	hong_trashcan_2020	22	Crab, eel, animal, fish, shells, starfish, plant, row, trash, fabric, fishing gear, metal, paper, rubber, wood	16	7.212	Multiple	Public	Segmentation	With context	-	Unbalanced	Even 480×270	RGB camera	Labeled subset of JAMSTEC E-Library of Deep-sea Images	https://conservancy.umn.edu/handle/11299/214865
kraft_autonomous_2021	UAVVaste	2021	Waste, no waste	Municipal/aerial in wild	-	kraft_autonomous_2021	1	-	-	772	Multiple	Public	Detection	With context	-	-	Even 3840×2160	RGB camera	Built	https://github.com/UAVVaste/UAVVaste
wang_multi-level_2020	MJU-Waste	2020	Waste, no waste	Municipal/indoors held by person	-	wang_multi-level_2020	1	-	-	2.475	Single	Public	Segmentation	With context	-	-	640x480	Microsoft Kinect RGBD camera	Built	https://github.com/realwecan/mju-waste/
longo_take_2021	-	2021	Glass, paper, plastic, aluminium, unsorted	Municipal/on-device	-	longo_take_2021	5	Glass (Coke, Beer Becks, Aperol Bottle, Heineken Beer Bottle, Jar, Red Beer, Water Bottle), Paper (Business Card, Candy Box, Cup, Flyers, Paper Bag, Juice Box, Magazine, Paper Napkins, Newspaper), Plastic(Blue Bottle, White Bottle, Green Bottle, Coffee Capsule Packet, Transparent Glass, White Dish, Green Dish, Red Dish, Cutlery, Estathè bottle, Fiesta Packet, Yogurt Cup, Bag), Aluminium(Coke Can, Fanta Can, Sprite Can, Redbull Can, Box, Coke Zero Can, Foil, Estathè Can, Jar Lid), unsorted(Backing Paper, Bic Pen, Pen, CD, Cigarettes, Lighter, Marker, Receipt)	39	3.126	Single	Public	Classification	Simple	Milan, Italy	Balanced	320×240	Logitech C920 wide-angle camera	Built	https://github.com/ANTLab-polimi/smart-waste-bin/blob/main/pics/Aluminium_Box/1552576356.62.jpg
Kaggle:techsash/waste-classification-data	Sekar	2019	Organic, recyclable	Municipal/general	-	liang_deep_2021	2	-	-	25.077	Single	Public	Classification	Simple	-	Unbalanced	Uneven	RGB camera	web	https://www.kaggle.com/datasets/techsash/waste-classification-data
Kaggle:sapal6/waste-classification-data-v2	-	2020	Organic, recyclable, Non-Recyclable	Municipal/general	-	-	3	-	-	27.982	Single	Public	Classification	Simple	-	Unbalanced	Uneven	RGB camera	Extended Kaggle:techsash/waste-classification-data	https://www.kaggle.com/datasets/sapal6/waste-classification-data-v2
Kaggle:arkadiyhacks/drinking-waste-classification	Drinking Waste Classification	2020	Aluminium Cans, Glass bottles, PET (plastic) bottles and HDPE (plastic) Milk bottles	Municipal/indoors	-	-	4	-	-	9.640	Single	Public	Detection	Simple	-	Unbalanced	Uneven	12 MP phone camera	Built + some TrashNet	https://www.kaggle.com/datasets/arkadiyhacks/drinking-waste-classification
Github:nikhilvenkatkumsetty/TrashBox	Trashbox	2022	glass, plastic, metal, e-waste, cardboard, paper, medical waste			-	7	Medical waste(Syringes, Surgical Gloves, Surgical Masks, Medicines), E-Waste (Electronic chips, Laptops and Smartphones, Applicances, Electric wires, cords and cables), Plastic (Bags, Bottles, Containers, Cups, Cigarette Butts), Paper (Tetra Pak, News Papers, Paper Cups, Paper Tissues), Metal (Beverage Cans, Construction Scrap, Spray Cans, Food Grade Cans, Other metal objects), Glass, Cardboard	25	17.785	Single	Public	Classification	With context	-	Unbalanced	Uneven	-	Web	https://github.com/nikhilvenkatkumsetty/TrashBox
Kaggle:mostafaabla/garbage-classification	-	2021	garbage; paper, cardboard, biological, metal, plastic, green-glass, brown-glass, white-glass, clothes, shoes, batteries, and trash	Municipal/general	-	-	12	-	-	15.150	Single	Public	Classification	With context	-	Unbalanced	Uneven	-	Web	https://www.kaggle.com/datasets/mostafaabla/garbage-classification
Kaggle:hseyinsaidkoca/recyclable-solid-waste-dataset-on-5-background-co	-	2021	Glass, metal, plastic	Municipal/indoors	-	-	3	black, orange, light green, dark green, grey background color	18	4.960	Single	Public	Classification	Simple	-	Balanced	410×390	Raspberry Pi camera module	Built	https://www.kaggle.com/datasets/hseyinsaidkoca/recyclable-solid-waste-dataset-on-5-background-co

Article	Year	Proposition	No. Categories	Categories	Model type	Architecture	Backbone	Sensors	Dataset	Prediction type	Performance metrics	Extension technique	Challenges and future work
wang_smart_2021	2021	Device open the recycling category list based on a photo taken by the user with his/her phone.	6	Plastic, glass, paper or cardboard, metal, fabric and other recyclable waste	CNN	Xception	Xception	RGB camera	wang_smart_2021	Classification	Average Acc: 94.44%. Confusion matrix. macro-precision (94.37%), macro-recall (94.04%), macro-F1- score (94.19%) macro-ROC-AUC (99.41%)	Transfer learning	Multiple waste detection on single image. Image segmentation
kapadia_dry_2021	2021	High speed system that uses machine vision and pneumatic blast for automatic waste segregation	3	Plastic bottles, metal cans, and tetra packs	CNN	Inception3	Inception3	RGB camera	kapadia_dry_2021	Classification	Average Acc: 96% Confusion matrix. Precision per class Recall per class. Sorting speed rate: 200-250 objects per minute	Transfer learning	Objects with the same brand and different material are miss-classified by the model
md_intelligent_2021	2021	Automatic sorting bin prototype of recyclable municipal solid waste	2	Pet bottles, LDPE chips packages	CNN	Inception-ResNet 2	Inception-Resnet2	Webcam	md_intelligent_2021	Classification	Average accuracy: 84 % Total true-positive data: 84, Total false-positive data: 16	None	Relatively smaller data set training is one of the limitation of the proposed model
rahman_intelligent_2020	2020	Design architecture of a waste management system based on deep learning and IoT	2-6	Inorganic (cardboard, glass, metal, paper, and plastic)	CNN	Resnet34	Resnet34	RGB camera	Trashnet	Classification	Average Accuracy: 95.3% Accuracy per class Confusion matrix	Transfer learning	Few categories of inorganic waste.
paulraj_automated_2016	2016	Development of a robotic mobile manipulation system for automated sorting of useful recyclables from MSW	3	aluminum can, plastic bottle and tetra	SVM with SURF features	-	-	Thermal camera (IR)	paulraj_automated_2016	Classification	Average Acc: 94.3% Precision, Recall, harmonic-mean per class, Av. Precision: 0.94 Av. Recall: 0.945, Av. Harmonic: 0.94	-	Improve classification accuracy on complex backgrounds, incorporate wider variety of materials, global path for navigation, developing a grasp planning algorithm to handle various sizes
korucu_investigation_2016	2016	investigate the usability of sound recognition for source separation of packaging wastes in reverse vending machines (RVMs)	4-11	metal (2 sizes), plastic (3 sizes), glass (3 sizes), cardboard (3 sizes)	SVM, HMM (Hidden Markov Model)	-	-	Microphone	korucu_investigation_2016	Classification	Average Acc: 100% Average Acc by type and mass: 88.6%, Acc by model, Acc by microphone	-	Small dataset, included half empty and full packaging wastes, combinations of sound and image classification approaches
funch_detecting_2021	2021	proof-of-concept method to classify the presence of glass and metal in consumer trash bags using sound recording and a A custom-built test rig	4	metal and mixed waste, glass and mixed waste, glass and metal, and pure mixed waste	CNN	Custom (Classic CNN)	-	Microphone	funch_detecting_2021	Classification	Av. acc: 98.14%, Av. precision: 99.49%, Av recall: 96.77%. ROC Confusion matrix	-	collecting more realistic data- sets of consumer trash bags, should be tested in more realistic settings.
zhang_computer_2021	2021	An automatic sorting machine was designed and made to test the performance of the models. It consisted of three main modules: the Computer-Vision Module, the Sorting Module, and the Customized Module	4-13	Recyclable [Fabric, metal, paper, plastic bottle, glass], residual [cigarette, plastic box, plastic bag, tissue], household food [Expired food, fruit], hazardous [Battery, medicine]	CNN	Custom (CNN-semantic retrieval model)	VGG16	RGB camera	zhang_computer_2021	Classification	Av. acc categories: 93.8% Av. acc sub-categories: 94.7%, Acc per category and subcategory precision, recall, and F1-score per category and subcategory	Transfer learning	the dataset is limited, More varieties of waste
koskinopoulou_robotic_2021	2021	implementation of an autonomous robotic system for the categorization and physical sorting of recyclables according to material types. development of a low-cost computer vision module	4	Aluminum, paper/cardboard, PET bottles, nylon	CNN	Mask R-CNN	Resnet50	RGB camera	koskinopoulou_robotic_2021	Segmentation	Total system Av. Acc (include robot): 90.2% Total system Acc per class, AP, AR, F1 per class, MAR (Mean av. Recall): 80.1% MAP (Mean av. Precision): 84.2%	Synthetic data	Current public datasets do not fit industrial waste characteristics (deformation and dirt), Dataset with not enough variability. Precision of the system is lower in real conditions.due to uncontrolled dirt on the recyclables. waste exhibits sea- sonal characteristics that can affect management strategies.
feng_robust_2020	2020	To enhance the detection model robustness to occlusion and small items, we proposed a robust waste detection method based on a cascade adversarial spatial dropout detection network(Cascade ASDDN).	204	2020 Haihua AI challenge waste classification	CNN	Custom based on Cascade RCNN (The network is composed of an FPN (Feature Pyramid Network) network and an ASDDN network.)	Resnet101	RGB camera	2020 Haihua classification	Detection	mAP: 62%	Adversarial Spatial Dropout, transfer learning	the number of training examples is not enough, and the number of training examples of each category is not balanced, which leads to the wrong classification results of the detection model
chen_garbage_2022	2022	Lightweight garbage classification model GCNet (Garbage Classification Network) is proposed. GCNet contains three improvements on ShuffleNet v2, including the design of parallel mixed attention mechanism (PMAM), the use of new activation functions, and transfer learning	4-14	Reciclable (towel, spitball, packaging bag, metal, paper box, bottle, book), wet garbage (orange, leaf, banana), hazard (bulb, battery), dry (plastic bag, glass, cullet)	CNN	Custom: ShuffleNet backbone with FreLu activation and a parallel mixed attention mechanism	Shufflenet2	RGB camera	chen_garbage_2022	Classification	Av. Acc: 97.9% Inference time: 105ms, Acc of motor rotation per class,	Transfer learning	In our real life, garbage has different forms and more categories. How to build an effective data collection platform or expand datasets by using adversarial learning. Ensure only a single object is presented by hardware design, Segmentation prediction
bobulski_deep_2021	2021	SIstem that uses a computer vision model to classify 4 types of plastics: PS, PP, PE-HD, and PET	4	PS, PP, PE-HD, and PET	CNN	Custom (Classic CNN)	-	RGB camera	Wadaba	Classification	Av. Acc: 74%	-	Further work will be carried out on covering the waste image database to include waste images under more realistic conditions, as well as from other types
singh_evaluation_2021	2021	Study of different state of the art architectures and optimizers to classify waste	6	glass, plastic, cardboard, trash, paper, metal	CNN	Resnext50	Resnext50	RGB camera	Trashnet	Classification	Confusion Matrix, Av. Acc: 98%	Transfer learning	little data as well as created a more realworld dataset with rotations, flips, and lightning effects.
mao_deep_2022	2022	documents the training and testing of an object detection model suitable for detecting domestic waste specific to Taiwan . it was necessary to compile the Taiwan Recycled Waste Database (TRWD)	6	plastic container, plastic bottle, metal, carton, paper container, and glass.	CNN	Yolo3	Darknet53	RGB camera	mao_deep_2022, Trashnet	Detection	mAP: 81.36%-trashnet, 92%-mao_deep_2022 Av. Precision per class, FPS	-	Datasets for waste classification should be targeted to the geographical place as objects appearance is different from place to place. Combine sensors to improve prediction. Deploy in a robot
lu_deep_2022	2022	this study, the deep-learning approach was applied to the multimodal fusion at the feature level for municipal solid-waste sorting.	12	Ceramic table, empty plastic bottle,	CNN	Custom: VGG16 + CNN (1D)	VGG16	RGB camera, Microphone	lu_deep_2022	Classification	Av. Acc: 95.8%, Confusion matrix	Transfer learning	**Large waste dataset, exploration of more modalities and fusion methods, how to deploy to practical bins**
qin_precision_2021	2021	lightweight deep learning model for solid waste classification developed using MobileNetV2, efficient for lightweight applications including edge computing devices and other mobile applications	6	Cardboard, glass, metal, Paper, Plastic, Trash	CNN+SVM	CNN+SVM	Mobilenet2	RGB camera	Trashnet	Classification	Av. Acc: 83.46%, Precision and Recall per class, Confusion matrix	Transfer learning	Hyperparameters optimization, compare complex architecture
song_optimization_2020	2020	A new automatic municipal waste classification algorithm is proposed, which is named DSCR-Net. The study builds an open-source dataset with large sample size.	4	Recyclable, organic, harmful, residual	CNN	Custom: Resnet+IR Blocks	Resnet	RGB camera	song_optimization_2020	Classification	Av. Acc 94.38%, Loss, Accuracy, Precision, Recall, AUC plot	-	-
ziouzios_intelligent_2022	2022	We propose an automatic system based on CNN with high accuracy, low power and costs for separating the waste materials	4	Paper, plastic, aluminum, other	CNN	Yolo4	CSPdarknet53	RGB-IR camera	ziouzios_intelligent_2022	Detection	Av. Acc 92.43%, FPS 60, Recall 93%, Mean IOU: 63.58%,	Transfer learning	location-based custom dataset that we used, it is difficult to directly compare our system to others found in the literature. real-time object detection capabilities of the other tools. The main disadvantage of our model is the hardware cost and energy consumption. A viable alternative for improving the suggested system's execution speed and effi- ciency is to execute the object detection algorithm on an FPGA board.
mingyang_research_2021	2021	A new waste sorting model is proposed to solve waste separation. Style transfer was used to increase the data	7	PP, PET, HDPE, paper, glass, tetra pack, can	CNN	Centernet	Resnet50	RGB camera	2020 Haihua detection	Detection	mAP: 89% FPS: 30	Style transfer	-
cai_research_2020	2020	Waste separation support vector machine based on feature extraction and transfer learning based on convolutional neural network. With the elaboration of a dataset	8	Fishbone, pericarp, tea residue, vegetable leaves, ceramics, cigarette, tableware, trashbag	CNN	VGG	VGG	RGB camera	cai_research_2020	Classification	Av.Acc: 97% Confusion matrix, precision and recall per class	Transfer learning	Test more architectures, increase the number of classes, bigger and complex (background) datasets, multiple object detection
zheng_encnn-upmws_2021	2021	a novel ensemble learning model called EnCNN-UPMWS, which is based on convolutional neural networks (CNNs) and an unequal precision measurement weighting strategy (UPMWS), is proposed for the classification of HSW via waste images.	4	Fourtrash: wet waste, recyclables, harmful waste, and dry waste Trashnet: glass, paper, cardboard, plastic, metal trash	CNN	Custom: 3 architecture assembled, top weighting strategy	Googlenet, Resnet50, Mobilenet2	RGB camera	Trashnet, fourtrash	Classification	(Fourtrash) Av. Acc: 92.9% Weighted F1-score: 0.93 Macro F1-score: 0.88 Confusion matrix (Trashnet) Av. Acc: 93.5% Weighted F1-score: 0.93 Macro F1-score: 0.93 Confusion matrix	-	more complicated tasks in waste image detection will be explored from the perspective of complex backgrounds.
caballero_inference_2021	2021	Fine-tune 3 state of art architectures on custom dataset for waste classification. Creation of dataset and optimization for deploy in low-specs devices	3	plastic bottles, aluminum cans, paper and cardboard	CNN	Resnet50, mobilenet1	Resnet50, mobilenet1	RGB camera	caballero_inference_2021	Classification	Av. Acc: 99.51% Acc per class	Transfer learning	Classify objects based on their visual appearance and not in their material composition. Perform object detection,
melinte_deep_2020	2020	Several types of Single Shot Detectors (SSD) and Regional Proposal Networks (RPN) have been fine-tuned on the TrashNet database. The network with the best performances is executed on one autonomous robot system	5	Cardboard, glass, metal, Paper, Plastic	CNN	SSD	Mobilenet2	RGB camera	Trashnet	Detection	mAP: 97.6% Recall: 94.4% F1: 95.98 Confusion matrix FPS: 9	Transfer learning	Prediction of waste size and camera distance. Deploy on mobile robotic
lv_garbage_2022	2022	Based on yolov5 algorithm, this paper proposes a method for rapid detection and classification of garbage. . This network model has the necessary technical conditions for the algorithm of waste sorting robots.	60	Cigarette, Unlabeled litter, Plastic film, Clear plastic bottle, Other plastic, Other plastic wrapper, Drink can, Plastic bottle cap, Plastic straw, Broken glass, Styrofoam piece, Disposable plastic cup, Glass bottle, Pop tab, Other carton, Normal paper, Metal bottle cap, Plastic lid, Paper cup, Corrugated carton, Aluminum foil, Single-use carrier bag, Other plastic bottle, Drink carton, Tissues, Crisp packet, Disposable food container, Plastic utensils, Food Can, Garbage bag, Meal carton, Rope & strings, Paper bag, Scrap metal, Foam food container, Foam cup, Magazine paper, Wrapping paper, Egg carton, Aerosol 1, Metal lid 1, Spread tub 1, Food waste 1, Shoe, Squeezable tube, Aluminum blister pack, Glass cup, Other plastic container, Glass jar, Six pack rings, Toilet tube, Paper straw, Plastic gloves, Tupperware, Polypropylene bag, Pizza box, Other plastic cup, Battery, Carded blister pack, Plastified paper bag,	CNN	Yolo5	CSPdarknet53	RGB camera	proenca_taco_2020	Detection	Av Acc: 95.49% mAP: 97.62% FPS: 5.52	-	-
seredkin_development_2019	2019	A model for detecting and classifying waste on a conveyor line using neural network image processing. Images from a camera are fed to a neural network input, which determines the position and type of detected objects. A database of more than 13,000 municipal solid waste images was created.	4	PET bottle, HDPE bottle, aluminum can, other	CNN	Faster RCNN	Resnet101	RGB camera	seredkin_development_2019	Detection	mAP: 64% AP per class	Transfer learning	-
calvini_developmentof_2018	2018	A new extension of Partial Least Squares Discriminant Analysis (PLS-DA), namely Soft PLS-DA, has been implemented. The proposed approach was tested on a real case study of plastic waste sorting based on near infrared hyperspectral imaging.	6	PET, PS, PVC, PP, HDPE, LDPE	Custom: Classification tree	Tree composed by PLS-DA (Partial Least Squares Discriminant Analysis) models	-	NIR camera	calvini_developmentof_2018	Detection	Mean Recall: 98.4% Mean Recall by node Recall per class	-	Predict objects on image, Sensor fusion with RGB cameras,
zhang_multi-label_2022	2022	a YOLO-WASTE multi-label waste classification model based on transfer learning is constructed to realize the fast recognition and classification of multiple wastes. a multi-label waste image dataset is also created	5	glass, fabric, metal, plastic, paper.	CNN	Yolo4	CSPdarknet53	RGB camera	zhang_multi-label_2022	Detection	mAP: 92.2% Detection time: 0.4s precision: 94.5% recall:92.22% F1-score: 93.33%. AP per class Precision-Recall plots Precision, recall, F1-score per class	Transfer learning	It is necessary to continue to collect and sort out various waste images, and to improve the detection ability of the model in complex scenes.
zhang_waste_2021	2021	a DenseNet169 waste image classification model based on transfer learning. the waste image dataset NWNU-TRASH is constructed	5	glass, fabric, metal, plastic, paper.	CNN	Densenet169	Densenet169	RGB camera	zhang_waste_2021	Classification	Av Acc: 82% Recall, Precision, F1-score per class Confusion matrix ROC-AUC, Prediction time: 22.56s	Transfer learning	Dataset with real life conditions, predict more types of waste, improve performance
chen_multi-objective_2021	2021	a multi-object solid waste classification and identification method based on transfer learning	5	Plastic, Paper, Fabric, Metal, Glass	CNN	Faster RCNN	Resnet50	RGB camera	chen_multi-objective_2021	Detection	mAP: 84.1% Average recall: 90.8%. Av Precision Across Scales: 90% Av. Recall across scales: 90%.	Transfer learning	There are four non ideal conditions, namely, sufficient light, insufficient light, object occlusion, and complex background.
andhy_panca_saputra_waste_2021	2021	object detection using YOLOv4 and YOLOv4-tiny with Darknet-53. The dataset consists of 3870 waste images	4	glass, metal, paper, and plastic	CNN	Yolo4	Darknet53	RGB camera	andhy_panca_saputra_waste_2021, trashnet	Detection	mAP: 89.59% Precision: 0.76 Recall: 0.90 F1-score: 0.82 Average IoU: 64.01%	-	Larger dataset with more samples and classes. Use version 5 of Yolo
duhayyim_deep_2022	2022	Deep reinforcement learning based recycling waste object detection and classification model for smart cities.	6	Cardboard, glass, metal, Paper, Plastic, Thrash	CNN	Custom: Mask R-CNN + DR Model	Densenet	RGB camera	Kaggle:asdasdasdasdas/garbage-classification	Detection	Av. Acc: 99.3% Confusion Matrix, Precision, recall, Accuracy, F1-score per class, recall: 0.975 precision:0.978 F1-score:0.977	hyperparameter optimization,	Deploy on mobile phones with realtime prediction
aqyuni_waste_2020	2020	we propose a waste segmentation method using Convolutional Neural Network based on the Encoder-Decoder approach of SegNet architecture	6	Waste, background	CNN	Segnet	VGG16	RGB camera	Trashnet	Segmentation	IOU 82.95%	-	This proposed method can only handle properly images where the color of the trash object contrasts with the background. Meanwhile, for garbage objects whose color is similar to the background (white), the segmentation results are not very good.
liang_deep_2021	2021	multi-task learning architecture (MTLA) based on a convolutional neural network, which can be used to simultaneously identify and locate wastes in images	4	organic, recyclables, hazardous, other wastes	CNN	Custom: Resnet, multi-level feature pyramid network, and a group of joint learning multi-task subnets	Resnet50	RGB camera	liang_deep_2021	Detection	F1-score: 95.5% Av. Precision: 81.5% ExactMatchRatio: 85% Accuracy: 97.2% Precision: 96% Recall: 96% F1-score: 96% Hammingloss: 0.04	Transfer learning	-
vo_novel_2019	2019	develops a deep neural network model for trash classification named DNN-TC which is an improvement of ResNext model to improve the predictive performance. Collect a dataset of 5904 images and 3 classes	3	Organic, Inorganic and Medical	CNN	Custom: modified Resnext101	Resnext101	RGB camera	vo_novel_2019, trashnet	Classification	Av. Acc: 98% (vo_novel_2019) Av. Acc 94% (trashnet) Confusion Matrix	Transfer learning	Deploy on real system. Improve performance by preprocessing input. Model for unbalance dataset
majchrowska_waste_2021	2021	an open-source framework that enables the detection and classification of litter was developed. The final pipeline consists of two neural networks: one that detects litter and a second responsible for litter classification.	8	background, bio, glass, metals and plastic, non-recyclable, other, paper, unknown litter	Cascade: detection-classification	EfficientDet, EfficientNet	EfficientDet, EfficientNet	RGB camera	Fusion of public datasets	Detection	AP (detection): 64% Av. Acc (classification): 75% Confusion Matrix Precision, recall, F1score per class	Transfer learning	Improve performance, small litter is still challenging. A balanced dataset. New version of efficientnet. Mount on robotic arm
panwar_aquavision_2020	2020	Proposed model detects and classifies the different pollutants and harmful waste items floating in the oceans	CNN	Glass, paper, metal, plastic	CNN	Retinanet	Resnet50	RGB camera	proenca_taco_2020	Detection	mAP: 81.5% Av. Precision per class	-	Increase dataset size
frost_compostnet_2019	2019	image classification model that categorizes the types of waste produced after eating a meal, which can be used in mobile applications to encourage users to correctly sort waste	3	trash, recyclable, compostable	CNN	Mobilenet	Mobilenet	RGB camera	frost_compostnet_2019	Classification	Acc: 77.3%	Transfer learning	Expand dataset on types of compostable materials. Improve model performance