REVIEW ON OBJECT DETECTION BASED MEDICAL WASTE COLLECTION ROBOT FOR HOSPITALS AND ISOLATION CENTERS

[1]Shaurya Cairae, [2]Kshitij Shinghal, [3]Amit Saxena, [1]Rahul Arora, [1]Sambhav Bishnoi
[1]UG Student, [2]HOD, [3]Assistant Professor,
Electronics and Communication Engineering Department,
Moradabad Institute of Technology, Moradabad

ABSTRACT

This paper targets on the condition that if the robot detects the garbage, it should moves towards it and should collect it. Different algorithms have been used for detection and collection of garbage previously in different models. For detection of the garbage, deep learning object detection algorithm is used with the help of the open-cv and Raspberry Pi and USB camera or Py-cam.

KEYWORDS- *object detection based garbage collection robot, Algorithm, training, testing, deep learning, open-cv, CNN, dustbin, Raspberry Pi, Arduino, USB-camera, py-cam.*

I. INTRODUCTION

In this paper, a review is done on the previous papers which have been used for this sole purpose. Most of these robots are used for the object detection only and some are used for detection and collection both. Trash differentiation from the Non-trash is very important as the model should be able to pick up the garbage perfectly. These models has their own disadvantages such as they are expensive and very fragile to use. Trained labor are required to operate these models. The advantage is that these models are very helpful in hospitals and isolation center where human intervention is very dangerous.

II. LITERATURE SURVEY

A. Automated Garbage Monitoring System Using Arduino [1]
This system comprises of a receiving part and a sending part both which helps in receiving the data. The transmitting unit of the model is attached with the dustbin of the model while receiving unit is provided with person in charge in local authorities. When the bin is full, it sends the SMS to the regarding authorities and then the dustbin is cleaned up. If the there is no proper checkup of the dustbin is done regularly, it will send the notification to the higher authorities and the action will be taken against the concerning person. The system is comprises of LED, SD card, Buzzer, IR sensor, Ultrasonic sensor, LCD, Transmitting and receiving antenna. A GUI has been created for the user friendly environment with help of the java language. A database has been created for storing the information about the personal picking up the trash and in order to monitor the system and as well as the cleanliness of the bin. GPS, GIS, web camera are used for the monitoring the project.

B. Autonomous Garbage Collector Robot [2]

This paper proposes a model which is used to pick up the garbage automatically on various places such as parks, footpaths, public areas etc. Basically this model will be able to move on a proper path and is not designed to move on the muddy areas. The movement of the robot is designed such that it

will pick up the garbage on its way. The path is predefined in the model. This model is comprises of a arduino as a microcontroller to control the movement of the robot. The components which are used are motor driver, a sufficient power supply. This particular model is very basic and can be improved in many ways. There is no method identify of identifying the garbage and it will just depend upon the logic of the program stored in the arduino. There is no dustbin attached to it for storing the garbage.

C. Autonomous Trash Collector Based on Object Detection Using Deep Neural Network [3]
This paper proposes an idea of collecting and detecting the garbage using the concept of deep learning. This project is divided into three parts:
1. Object detection
2. Trash detection
3. Trash collection

In object detection, deep learning algorithm is used. There is no pre-trained model is used. The model has been trained from scratch. The algorithm which is used is SSD. The dataset is collected for training the model from. Keras, python and open-cv is used for coding the training part of the model. Web cam is attached with robot which helps in imaging the trash. The web cam or the Py-cam is connected to the raspberry pi which helps in the object detection. The algorithm uses the single shot detection technique. In the trash detection part, trained model helps in identifying the trash which has been trained on various kinds of images. When the identification is done, the robot looks for the signal from the raspberry pi. The division of the dataset is done in such a way that 70% of the data is taken for the training, 10% for validation and 20% for testing the result. Learning rate is taken 0.001 with 128 batch size. The activation which is used in the hidden layers is ReLu function with softmax as the output activation function. The image size which is given to the model must of 64*64*3 in size. The architecture consists of 128 and 2 neurons. Training is done on the different machine and model is pickled and can be used in any other machine or Raspberry pi. The trash collection is done with two cup like structure which pick up the trash on detection. The distance is measured with the help of the ultrasonic senor. The motor driver is used to control the movement of the robot and the structure to pick up the trash. This model is a perfect example of the modern technology which uses combination of the artificial intelligence and hardware components.

III. GAPS IDENTIFIED FROM LITERATURE SURVEY

The gaps that are identified in the above literature survey are that model which are made using the parts related to hardware or in other words model which do not use the technique of automatic collection of garbage using object detection is not enough in today's world as it would still include the involvement of humans which would increase the risk of medical issues. People who are working as a garbage collector in hospitals and isolation centers, there is need of model or a robot which can automatically detect the garbage and collect it without human intervention. The concept which is used in "Autonomous Trash Collector Based on Object Detection Using Deep Neural Network" (In above literature survey), which uses a Neural network based algorithm for garbage detection i.e. SSD which detects the garbage in one shot. This model works perfectly fine with today's world requirement and reduces the health risk problems with minimum human intrusion. The problems is that to train a model with a large dataset is not possible on an every system available as it requires a high computational power plus no use of a GPU in the given model makes it even slower. The other problem with this model is that it's moving mechanism. After it detects the garbage, there is no proper methodology provided for movement of the robot.

IV. PROPOSED WORK

Object detection based garbage collection robot is basically divided into two parts:
i. Object detection and trash detection
ii. Movement of the robot and the trash collection.

The object detection part consist of a power supply of 5V 3A which given to raspberry pi 4. Raspberry pi is connected to a USB camera which is used for locating the trash. The raspberry is connected to the arduino Nano which is connected to the motor driver which further controls the movement of the robot. For measuring the distance IR sensor is used, dc motors for moving and

controlling the direction of the robot. To check whether the dustbin is full ultrasonic sensor is used. The pick up the trash lifter gripper is used which picks up the trash and put in the bin. For object detection a pre-trained model has been used of MobileNetSSD. The reason is to use this algorithm is that FPS of this algorithm are much better than the GoogleNet, Faster RNN and YOLO. Using the pre-trained model reduces the complexity and also the computational power required to train the model.

V. BASIC BLOCK DIAGRAM

In Figure 1, the basic block diagram is shown for the object detection based garbage collection robot. This is consists of a power supply, raspberry pi, USB camera, Arduino Nano, motor driver, dc motors, lifter gripper. Camera detects the trash and raspberry pi sends the signal to the microcontroller. This in turn gives high voltage to the motor driver which drives the robot motors and lifter gripper picks up the trash.
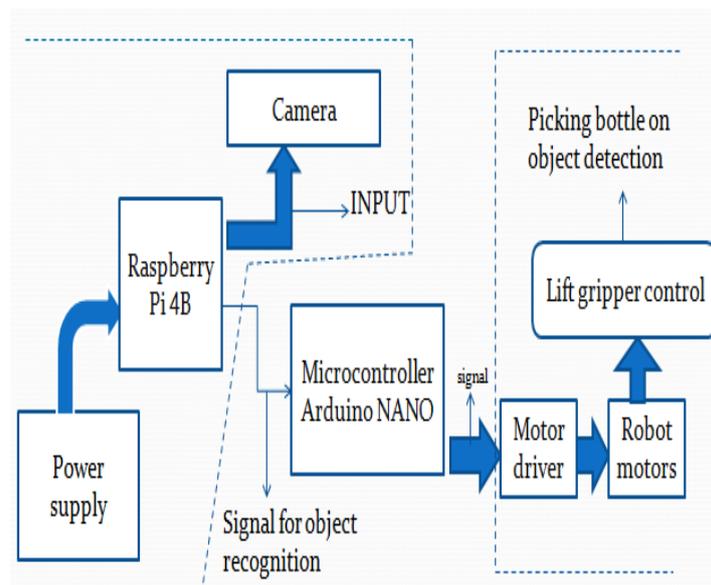

Fig 1: Basic block diagram

VI. FACTORS TO CONSIDER IN DESIGNING MODEL

The following are some of the key points that should be considered in order to built and full functioning robot.
a. Battery life
Since for the proper functioning of the system, battery life is very important factor as all the working and the devices are battery dependent.
b. Optimized Algorithm
Optimized algorithm for object detection is very important as the speed is very much important in today's world. For that an algorithm with best FPS and object detection capability must be chosen.
c. Robust in nature
The model that is constructed must be robust in nature i.e. it should not be affected by a little wear and tear. The microcontroller, raspberry pi and camera must kept in the safe location for proper functioning of the robot. Wiring of the model must be kept perfectly secure. The model should be able to work in different locations.

VII. EXPECTED RESULT

The proposed model will be able to detect the garbage and on detection it will be able to collect the garbage. The use of the pre-trained model removes the unnecessary problem of system with a good computational power. MobileNetSSD is a fast algorithm with a tendency to detect a variety of objects.

VIII.   CONCLUSION

In this paper we have reviewed various systems for garbage collection, garbage detection and monitoring system which uses the Arduino, GSM, GIS and web camera and also different sensors for checking whether the dustbin is full or not. We have also reviewed the system which uses the deep learning concept with hardware that uses artificial intelligence learning algorithm for trash detection and for collection part microcontroller, motor driver and a robot is used. There are some following factors to be considered for the making a better model such as battery life, robustness of the model and optimized algorithm.

IX.   FUTURE ASPECTS

The issues that are being observed after reviewing different systems in this papers are mainly are that if the model is completely based on the microcontroller part and not uses the image processing, the automation is very difficult which again makes the intervention of the human necessary for collecting and disposing the garbage and this can be very dangerous as it can lead to health problems and during this time in which social distancing is must this can follow up to some serious problems. The other issue is if we use a system with a combination of a deep learning and microcontroller to move the robot, it makes the system expensive and it heavily depends on the algorithm used for detection of the trash and algorithm that has been used in the previous system are slow and has been outdated. The later issue is must to be solved. So these issues should be considered while designing the system that uses the both hardware and artificial intelligence as combination with an optimized algorithm.

REFERENCES

[1]. Things‖ international journal of innovative research in electrical, electronics, instrumentation and control engineering, issn (Online) 2321 –2004, Vol. 4, Issue 4, April 2016.

[2]. Islam, M.S. Arebey, M. ; Hannan, M.A. Basri, H, "Overview for solid waste bin monitoring and collection system" Innovation Management and Technology Research (ICIMTR), 2012 International Conference, Malacca, 258 – 262

[3]. Kanchan Mahajan, Prof J.S.Chitode ―Waste bin monitoring system using Integrated Technology‖, International Journal of innovative Research in science engineering and technology, Vol 3, Issue 7, July 2014

[4]. Abdurahman, Fetulhak & Aweke, Sileshi & Asefa, Chera. (2019). Automated Garbage Monitoring System Using Arduino. 64-76. 10.9790/0661-2001016476.

[5]. Parashar, Shikha & Tomar, Pankaj. (2018). Waste Management by a Robot- A Smart and Autonomous Technique. Journal of Electronics and Communication Engineering. 13. 31-36. 10.9790/2834-1303023136.

[6]. J. Jin, J. Gubbi, S. Marusic, and M. Palaniswami, "An information framework for creating a smart city through internet of things," IEEE Internet of Things Journal, vol. 1, no. 2, pp. 112–121, 2014.

[7]. Hossain, Mst & Debnath, Bidya & Anika, Adrita & Al-Hossain, Md. Junaed & Biswas, Celia & Shahnaz,. (2019). Autonomous Trash Collector Based on Object Detection Using Deep Neural Network. 10.1109/TENCON.2019.8929270.

[8]. S. Nolfi, "Evolving non-Trivial Behaviors on Real Robots: a garbage collecting robot", Institute of Psychology, National Research Council, Rome, Italy. Technical Report 96-04, March 1996

[9]. S. Khandare, S. Badak, Y. Sawant, S. Solkar, "Object Detection Based Garbage Collection Robot", International Research Journal of Engineering and Technology (IRJET), Volume 05, Issue 03. March 2018.

[10]. S. Parashar, P. Tomar, "Waste Management by a robot- A Smart and Autonomous Technique", IOSR Journal of Electronics and Communication Engineering(IOSR-JECE), Volume 13, Issue 3, Ver. 2(May-June 2018), pp. 31-36

[11]. G. Sivasankar, B. Durgalakshmi, K. Seyatha, "Autonomous Trash Collecting Robot", International Journal of Engineering Research and Technology(IJERT), Volume 6, Issue 04, April 2017