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Automatic Object Sorting using Deep Learning

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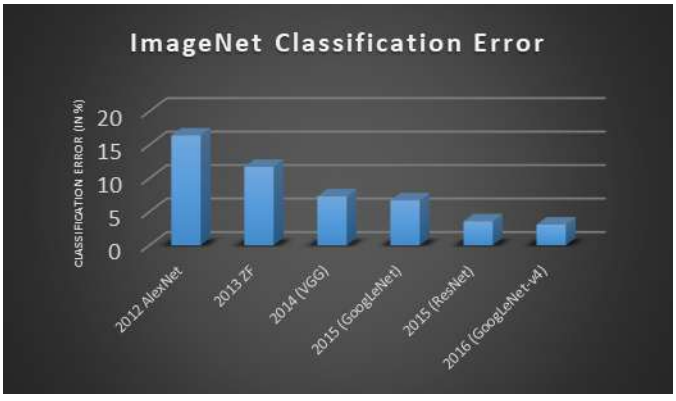
Abstract - *Deep learning using neural networks has grown to be revolutionary. It has applications in almost every possible field. This research has designed and developed a sorting mechanism with the help of deep learning. The developed sorting mechanism would help incorporate objects with more than one characteristics be distinguished. For the physical implementation, Raspberry Pi is used as a controller. It controls the servo motor mechanism, which controls the mechanical handling. This mechanical handling further helps to put the object in designated place. This system can be adopted in any factory where objects of more than one distinguishable physical characteristics.*

Key Words: Raspberry Pi, Deep Learning, Servomotors, raspberry pi camera, Convolution Neural Network

1. INTRODUCTION

In 2012 when Alex Krizhevesky et al.[1] proposed AlexNet, Deep Learning took a huge boom and a huge amount of research came up in past few years. Neural networks have almost solved the problem of vision. In upcoming decades scientist will be close to solving intelligence. With the more research going on in the field of vision, It has became interdisciplinary and has expanded from computer science to almost every field. The Error rate of machines in vision has now became lesser than that of humans (5%) as Graph I shows the advancement in Deep Learning over the past few years.



Graph I: ImageNet Classification Errors [2]

The computing capabilities of modern computers have increased exponentially in past decades. This had made the use of neural networks more and more common in modern applications. It has emerged as a field in which there is lot to explore.

The process industry aspect of using deep learning as a solution has remained much unexplored. PLC's rule the industries and most of the sorting mechanism are PLC controlled. Many new methods have emerged for sorting of various items. When it comes to sort very different objects. It has to go through various processes adding a huge amount of time. This is not favourable because of the pace required in processing industry. Adding a device (camera) which can help us distinguish between different objects and simultaneously running a mechanism to separate objects.

The concept of object detection has been applied to compare objects. It will help in reduction of time used for sorting objects in industries by eliminating the extra processes required.

2. RELATED WORKS

Various previous efforts in object sorting using have been made previously, M. Sabnis et al. [3] gave an approach to classify objects of by image processing algorithm on the parameters like color, shape and texture.

There have been few previous proposals to implement deep learning in industrial applications. A. Luckow et al. [4] proposed automotive use of deep learning in Industries. T. Wuest et al. [5] gave a Machine learning approach to deal with the industrial problems. None of these efforts explained the actual application deep learning could have in process industry.

3. PROPOSED CONCEPT

The whole process make use of a DC and servo motor, camera interfaced with raspberry pi and a computer as shown in fig II. The DC motor control the transportation. The servos control the sorting of objects. The raspberry pi act as the controller, which controls the action of DC and servo, motors. Raspberry pi also controls the action of camera, which clicks the photo of object. The Personal computer runs the deep learning algorithm, which gives us information about object.

The whole working system is divided into three parts, which are as follows:

1. Controller and Data acquisition

Raspberry pi controls the whole mechanism of process, from controlling servo and dc motors to controlling the camera. By controlling the servo and DC motors, it handles whole

object handling part. The object handling involves the movement of object from dc controlled conveyer belt, through servo motor mechanism to the designated box. It controls the action of dc motor. It also controls the angle of servomotor to guide the movement of the object into its designated place.

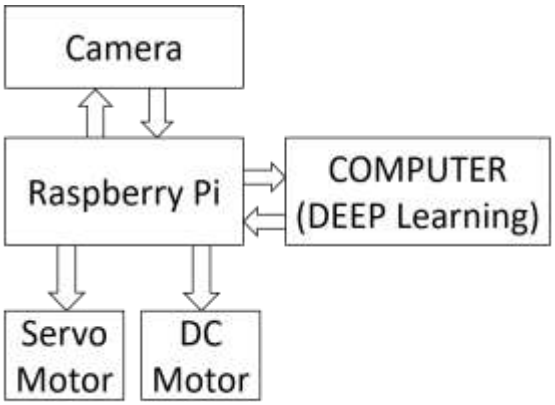


Fig I: Block Diagram of Design

2. Sorting and transport mechanism

The object is transported using conveyer belt moved using dc motor. IC L293D and raspberry pi control the rotation of dc motor, which is stopped for a while when the picture is taken at the end of conveyer. After the analysis of picture in computer, the control signal rotates the servomotor at a particular angle. The servomechanism connects the path for the object to its designated destination.

Here the objects are balls and the four category of objects are chosen here for the demonstration of this concept, which are as follows:

a) Red and Small(RS)

b) Red and Big(RB)

c) Green and Small(GS)

d) Green and Big(GB)

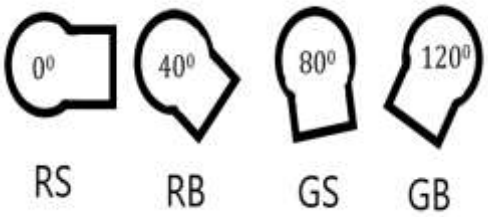


Fig II: Rotation of servo

There are four boxes placed for each category of object at the end of conveyer belt. The servomotor is set at an angle signaled by controller, i.e. from 0^0 to 120^0.

Table -1: Angular rotation of servos

Angles for different objects	
Category	**Angle**
RS	0^0
RB	40^0
GS	80^0
GB	120^0

3. Deep Learning

Deep learning plays the main role in object detection. It is carried out in a computer to which the photo of object is sent from raspberry pi. Object detection identifies the object, the computer sends the signal to raspberry pi, and the action of servo and dc motors takes place.

a) Dataset

All the data of objects is collected by clicking picture of objects in different lighting conditions and different background. The collection of data was manual and was in two category for simplicity i.e. Red and Green, but the classes can be changed according to our need. The data can be collected according to the classes.

460 images of both classes are collected. They are split into training and testing set. Training set contains 360 images and testing set contains 100 images for both the categories.

b) CNN Architecture

The object detection made use of GoogLeNet architecture. Which is an 22 layer deep model. This very efficient network achieves state-of-the-art accuracy using a mixture of low dimensional embedding's and heterogeneous sized spatial filters [6].

c) Transfer Learning

Transfer learning was achieved using the pre-trained GoogLeNet architecture from ImageNet. Instead of last layer, feature extractor for new dataset is added. Which would draw a box around the object. The inspiration for was taken from Tensorflow object detection API [7].

Comparison is made by calculating the area of box bounding the object. Initial comparison decides the size of bigger and smaller object.

4. WORKING

The Process of sorting item starts from conveyer belt. Fig V shows the object placed on the conveyer belt. At first, the conveyer belt starts moving and thus it places the first object just below the camera and stops for a second. The camera clicks the photo and send it to the computer using raspberry pi. The computer using Deep Learning identifies the object and its other characteristics like colour and size. After the identification, the signal is sent to the Raspberry pi. Raspberry pi identifies the signal and align the servo according to the object. Now, the conveyer belt starts again and the whole process is repeated.

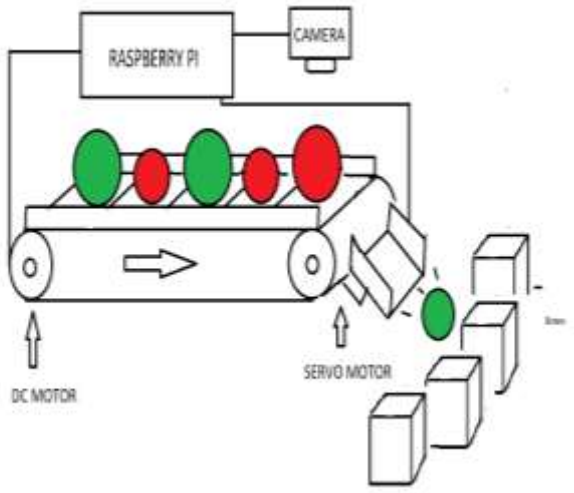
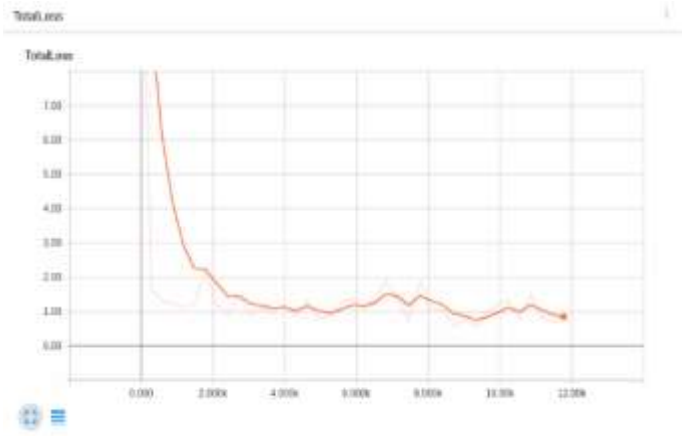


Fig III : Working Mechanism

5. RESULTS

The Deep Learning algorithm was applied to simple objects like balls of different colour and size. The training was done until the loss was brought down below 1 as shown in graph II. The training took around 15 hours to complete. 90% detection accuracy is obtained.



Graph II: Loss during Training

The conveyer belt will not add any kind of noise because the background is clear. This helps in the identification of object without any error or mislead in detection. The system with the help of deep learning is more efficient and further modifications can also reduce the sorting time. It can be used in Airports, where luggage has to be sorted. The luggage can be identified and sort accordingly. It can also make impact in various other sectors.

6. FUTURE WORK

Deep Learning is a promising field; it will revolutionize the automation sector in upcoming decades to come. Deep Learning can influence almost every aspect of manufacturing sector. Sorting is just a small part of process industry, more research can be done in other parts of manufacturing. This will further help in automation and increasing productivity by saving time leading to development of humanity.

7. CONCLUSION

In this paper, we have studied a new method for sorting items; this method can have applications not only in manufacturing industries but also in various places where sorting is necessary.

The result showed that the object detection is flawless with almost no chances of error. This will prevent financial losses, which may result by the use of older methods. It can guarantee 0 % error if superior hardware for training purpose are used. A not so superior CPU was used for training of the model.

This work represent the onset of artificial intelligence in manufacturing industry. The more and more industries are going to adapt Deep Learning in upcoming years. Deep learning is the future of industries.

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REFERENCES

[1] Alex Krizhevsky, Ilya Sutskever, and Geoffrey E. Hinton. 2012. ImageNet classification with deep convolutional neural networks. In Proceedings of *the 25th International Conference on Neural Information Processing Systems - Volume 1 (NIPS'12), F. Pereira, C. J. C. Burges, L. Bottou, and K. Q. Weinberger (Eds.), Vol. 1. Curran Associates Inc., USA, 1097-1105.*

[2] http://image-net.org

[3] M. Sabnis, V. Thakur, R. Thorat, G. Yeole, C. Tank *International Journal of Computer Engineering and Applications*, Volume IX, Issue V, May 2015.

[4] A. Luckow, M. Cook, N. Ashcraft, E. Weill, E. Djerekarov and B. Vorster, "Deep learning in the automotive industry: Applications and tools," *2016 IEEE International Conference on Big Data (Big Data)*, Washington, DC, 2016, pp. 3759-3768.

[5] Thorsten Wuest, Daniel Weimer, Christopher Irgens & Klaus-Dieter Thoben (2016) Machine learning in manufacturing: advantages, challenges, and applications, Production & Manufacturing Research, 4:1, 23-45, DOI: 10.1080/21693277.2016.1192517.

[6] Szegedy C., Vanhoucke V., Ioffe S., Shlens J., Wojna Z. Rethinking the inception architecture for computer vision. In Proceedings of *the IEEE Conference on Computer Vision and Pattern Recognition*, 2016:2818–2826.

[7] "Speed/accuracy trade-offs for modern convolutional object detectors."Huang J, Rathod V, Sun C, Zhu M, Korattikara A, Fathi A, Fischer I, Wojna Z,Song Y, Guadarrama S, Murphy K, *CVPR 2017*.