# SNOOP.PY / Quality control filter

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***Abstract*-** Quality control (QC) is a process through which businesses seek to ensure that product quality is maintained or improved. Quality control requires the company to create an environment where management and employees strive for perfection. It also helps with the perception of a product or a company in the eyes of its consumers, as it helps build a reputation for the brand of Quality and Reliability of Products.

Quality control has traditionally been done manually, using various methods; such as visually verifying, weighing the product, testing the product etc. This requires a large number of people to keep up with the process if demand is high. Scaling production while keeping costs down and ensuring quality becomes arduous and complicated. With Snoop.py, we aim to automate some of this process, bypassing the drawbacks of the manual method of Quality Control prevalent in the Industry.

***Index Terms***- Quality Control, OpenCV, SVM, Machine Learning, Image Recognition, Image Segregation.

1. **Introduction**

Quality control is a critical aspect of any industry that deals with physical products. The manual inspection process is time-consuming and prone to human error, which can result in incorrect product classification. This project addresses this issue by automating the segregation process using OpenCV and machine learning. The system is designed to accurately distinguish between defective and usable products, reducing the time and resources required for manual inspection. It’s user-friendly interface and efficient performance make it an ideal solution for quality control in a wide range of industries. In this paper, we will provide a comprehensive overview of the project, including the technology used, system architecture, and user guide.

The model utilizes the latest advancements in computer vision and machine learning to provide a highly effective solution for product segregation. OpenCV, a powerful computer vision library, is used to capture and analyze images of products, while machine learning algorithms are employed to classify the products as either defective or usable.

The system is designed to be flexible and can be easily configured to meet the specific requirements of different industries. Additionally, the user-friendly interface and intuitive design make it simple and straightforward for operators to use, even without prior technical expertise.

With the Snoop.py project, industries can significantly improve the accuracy and efficiency of their quality control processes, reducing the risk of incorrect product classification and increasing overall productivity. This paper provides a comprehensive overview of the Snoop.py project, including the technical details, user guide, and troubleshooting tips, making it an invaluable resource for anyone interested in implementing a cutting-edge solution for product segregation.

1. **Study of similar projects or technology\ literature review**

In recent years, machine learning and AI-based systems have become increasingly popular in the field of quality control. The use of these technologies has brought about significant improvements in the accuracy and efficiency of quality control processes, leading to enhanced product quality, increased productivity, and reduced costs.

Some examples of similar projects are:

1. A project done at UniMAP, Malaysia on the Detection of defects in PCB manufacturing using Artificial Intelligence.
2. A study at The Wuhan University of Technology investigated the use of deep learning algorithms for detecting defects in steel products.
3. **Basic concepts/ Technology used**

Python is a high-level, interpreted programming language that is widely used for various applications, including scientific computing, data analysis, and web development. Python 3 is the latest version of the Python programming language, released in 2008. It has a vast and active community, which has developed a large number of libraries and packages for various purposes. This makes it easy to use existing libraries and modules to build new applications. It also has a simple and easy-to-read syntax. Despite its simple syntax, It is a high-performance language, thanks to its efficient memory management, built-in support for concurrency, and optimized libraries. This makes it an ideal choice for building complex applications that need to perform well. Python 3 was used for this project due to its large library support, ease of use, and high performance, making it an ideal choice for building a computer vision and machine learning-based solution for product segregation.

Artificial Intelligence (AI) is the simulation of human intelligence in machines that are designed to think and act like humans. It involves creating systems that can learn from experience, understand natural language, make decisions, and perform tasks.

Machine learning is a subfield of artificial intelligence that deals with the development of algorithms that can learn from data and make predictions or decisions based on that data. Machine learning algorithms are trained on large amounts of data and use statistical techniques to find patterns and relationships within that data. These algorithms can then be used to make predictions about new, unseen data, and can be improved over time as they are exposed to more data. It is used in a wide range of applications, including image recognition, natural language processing, and recommendation systems.

OpenCV is an open-source computer vision library that provides a wide range of tools and algorithms for image and video processing. It supports many programming languages, including Python, and is widely used in industries such as robotics, automation, and security. It can be used for tasks such as object detection, face recognition, and image filtering, and is an essential tool for many computer vision applications.

Support Vector Machine (SVM) is a supervised learning algorithm used for classification and regression analysis. It finds an optimal boundary between classes by maximizing the margin between them, using a mathematical concept known as a hyperplane. SVM can handle both linear and non-linear data, making it a versatile and powerful tool for machine learning.

1. **PROJECT COMPONENTS**

Python: Python was used as the programming language for the Snoop.py project, providing a simple and flexible environment for the development of complex applications.

OpenCV: OpenCV was used to perform computer vision tasks, such as image processing and object detection, in the Snoop.py project.

SVM: SVM was used as a machine learning algorithm to classify defective and usable products in the Snoop.py project, based on the features extracted from the images using OpenCV..

1. **Proposed Model / Architecture / Methodology/ Model Tool**

This project uses a combination of computer vision and machine learning techniques to segregate defective and usable products. At the core of the project is a model or tool that leverages the OpenCV library for image processing and the Support Vector Machine (SVM) algorithm for machine learning and classification.

The following steps describe the working of the project's model or tool:

Importing the required libraries: The script starts by importing the OpenCV, NumPy, and Pickle libraries. These libraries are necessary for image processing, feature extraction, and model serialization, respectively.

Loading the dataset: This function retrieves both usable and defective objects as examples from a directory and maintains them in a list for subsequent use in training the model. The images are also annotated, allowing the model to distinguish between them.

Preprocessing the image and extracting features. The function initially scales the image to a standardized size and then transforms it into grayscale, simplifying the subsequent feature extraction procedure.

Training the model: The dataset is divided into training and testing datasets, then further divided into features and labels to facilitate the training process using the scikit library's `train\_test\_split` function. The training data is then fed into an SVM library's SVC model to generate a trained model. The accuracy of the model is determined by comparing the features and labels of the testing data; an ideal accuracy score lies between the extremes of underfitting and overfitting the dataset. The trained model is saved as a .pkl file using the joblib library, and can be effortlessly loaded as required in the future.

With a trained model, any image of the object can be inputted and the model will accurately predict the quality of the product. This code is a basic implementation of a machine learning-based quality control filter and can be modified and extended to suit specific needs and requirements.

1. **Implementation and results**

This project was carried out in multiple phases. Initially, a large dataset of images featuring both defective and usable products was collected and labeled. During the development phase, the model was tested using TWS earphone cases, labeling open cases as defective and closed ones as usable. The OpenCV library was utilized to pre-process the images by applying filters and other image processing techniques to improve their quality and extract relevant features.

The dataset was subsequently divided into training and testing sets, and then into images and labels. An SVM model was then trained with the pre-processed images and labels to learn how to classify them as either defective or usable. The model's performance was assessed by testing it with a separate set of images.

We found that the trained model is extremely efficient and consistently provides near-perfect accuracy in distinguishing between defective and usable products when presented with a large dataset. When compared to manual inspection, the model's results are highly efficient and consistent.

These results demonstrate the potential for computer vision-based approaches to improve the efficiency and accuracy of quality control inspections in manufacturing and other industries.

1. **SOCIETAL IMPACT AND FUTURE SCOPE**

Machine learning and AI-based quality control systems have the potential to bring about positive societal impacts by improving the efficiency and accuracy of quality control processes in various industries. Some of the key benefits of these systems are:

Increased Productivity: By automating quality control processes, machine learning and AI-based systems can significantly increase productivity and reduce manual labor costs. They can also perform quality control checks faster and more accurately than humans, reducing the risk of errors.

Improved Product Quality: By using machine learning algorithms to analyze large amounts of data and detect patterns, these systems can provide more accurate and consistent results, leading to improved product quality. This can also reduce the number of defective products that make it to the market, which can improve customer satisfaction and reduce waste.

Better Resource Utilization: By reducing the need for manual labor and improving the accuracy of quality control processes, machine learning and AI-based systems can help companies make more effective use of their resources. They can also help companies reduce costs and increase profits.

Enhanced Customer Experience: By reducing the number of defective products that reach customers, machine learning and AI-based quality control systems can enhance the customer experience and increase customer satisfaction. This can also help companies build a positive reputation and improve brand loyalty.

The future scope of machine learning and AI-based quality control systems is promising, with many opportunities for further development and improvement. Some of the areas that hold great potential for future advancements include:

Integration with IoT: By integrating machine learning and AI-based quality control systems with the Internet of Things (IoT), it will be possible to collect even more data and perform even more sophisticated analysis, leading to even greater accuracy and efficiency.

Improved Performance: Machine learning algorithms and AI models are constantly evolving, and their performance is continually improving. In the future, these systems are likely to become even more accurate and capable, with the ability to perform even more complex quality control checks.

Enhanced User Experience: As machine learning and AI-based systems become more user-friendly and accessible, it will be possible for even more companies to adopt these technologies and reap the benefits of improved quality control processes.

Wider Adoption: With the increasing adoption of machine learning and AI-based systems in various industries, it is likely that we will see more companies investing in these technologies in the future. This will lead to even greater innovation and improvement in quality control processes.

In conclusion, the impact of machine learning and AI-based quality control systems on society is significant and positive. With the potential for further development and improvement in the future, these systems have the potential to revolutionize the quality control industry and bring about a new era of efficiency and accuracy.

1. **CONCLUSION**

The Quality Control Filter is a example of the potential for machine learning and AI-based systems to revolutionize quality control processes. By using OpenCV and machine learning algorithms, this project was able to accurately and efficiently segregate defective and usable products. The study of similar projects and technology showed the increasing adoption and success of machine learning and AI in the field of quality control, and the positive societal impacts that these systems bring.

The integration of Python 3, OpenCV, and SVM in the Snoop.py project highlights the versatility and effectiveness of these technologies when combined. The use of SVM, in particular, proved to be a highly effective method for classifying defective and usable products, and the project's results demonstrate the potential for further improvement in the future.