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In the modern pharmaceutical industry, the quality assurance of tablets plays a crucial role in ensuring consumer safety and regulatory compliance. Even minor physical defects in tablets—such as chipping, cracking, or absence of active ingredients—can lead to reduced efficacy and consumer dissatisfaction. Traditionally, quality control relies heavily on manual inspection, which is not only time-consuming but also prone to human error.

This project, titled "Automatic Defect Detection and Sorting System for Pharmaceutical Tablets Using Image Processing," presents a machine learning-based approach for real-time tablet inspection and sorting. Using a camera setup and a pre-trained deep learning model (ResNet50), the system identifies whether a tablet is broken, perfect, or contains no medicine. Once classified, the result is communicated to an ATmega328P microcontroller, which controls a servo motor to sort the tablets accordingly.

This system enhances accuracy, reduces inspection time, and provides an efficient and scalable solution for pharmaceutical quality control.

1.1 Scope of the Project
The project aims to automate the defect detection and sorting process of pharmaceutical tablets through the following objectives:

To design and implement a real-time image processing-based classification system.

To train a deep learning model (ResNet50) to classify tablets into three categories: broken, perfect, and no medicine.

To interface the classification system with an ATmega328P microcontroller.

To control a servo motor for mechanical sorting of tablets based on classification.

To achieve high classification accuracy using a self-collected dataset of 300 images.

This project has significant implications in pharmaceutical manufacturing units where real-time defect detection is critical for ensuring product quality.

1.2 Operating Environment – Hardware and Software
Hardware:

Camera Module: Captures real-time images of tablets.

ATmega328P Microcontroller: Processes commands for sorting logic.

Servo Motor: Performs physical sorting based on classification.

Power Supply: To provide necessary voltage levels to all components.

Software:

Python: Used for image processing and running the deep learning model.

ResNet50 (Pre-trained Model): For tablet image classification.

Arduino IDE: For programming the ATmega328P microcontroller.

Embedded C: To interface microcontroller with actuators.

1.3 Brief Description of Technology & Tools Used
ResNet50:
ResNet50 is a deep convolutional neural network with 50 layers, known for its ability to extract deep features using residual learning. It is widely used for image classification tasks. In our project, a pre-trained ResNet50 model is fine-tuned on a dataset of 300 images for classifying pharmaceutical tablets.

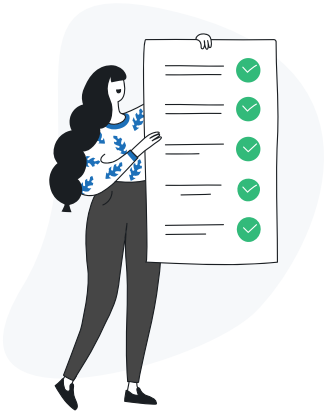
OpenCV (optional):
OpenCV can be used for initial image preprocessing (cropping, resizing, etc.) before feeding the images into the model.

ATmega328P:
A low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. It interprets signals from the processing unit and actuates the servo motor accordingly.

Servo Motor:
Used to sort tablets based on the classification result by physically moving them to separate bins or paths.

Camera Module:
Used to capture high-resolution images of tablets as they fall under the camera frame in real-time.

Embedded C & Arduino IDE:
Used for interfacing and controlling hardware components like ATmega328P and servo motor.



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