# Vision-Based Bulk Counting
## Sorin Nucham - Business Unit Manager, Pharma , DATA Detection Technologies Ltd

**Introduction**

Until the 1970's, tablet and capsule dispensing was a highly time-consuming manual operation resulting in costly errors.

As more and more new and expensive medications were developed by both branded and generic pharmaceutical companies, the need for automated counting and dispensing solutions quickly became a critical part of the industry.

Today, automatic counting machines are a must-have product for every pharmaceutical company or contract pharmaceutical packer, large or small.

The most common way of counting today is by traditional multichannel machines.

**The challenges of traditional counting machines**

Vibratory counting machines, also called 'multichannel counting machines' are based on feeding channels in which the tablets align in one form, passing through the scanning area one by one. This technology, although offering flexible changeovers between tablet types, requires a large footprint and is difficult to maintain.

Furthermore, high-speed feeding, poor overlap detection, wrong flap timing adjustments and dust, affecting the sensors and gates, all contribute to inaccuracy.

So although quite a few counting machine manufacturers around the world today claim to provide the best counting and dispensing solutions, they all have several characteristics in common:

- **One-at-a-Time:** All traditional counting methods count one tablet at a time, which requires separation of the tablets through long vibrating trays, in order to prevent overlapping. The outcome is a very difficult feeding optimization process, in which the difference between a skilled and less skilled operator can be 30-40% in machine output.
- **Dust:** Traditional counting machines all struggle with the challenge presented by large amounts of dust from uncoated tablets. The dust covers the counting sensors, which requires frequent and time-consuming cleaning breaks, as often as every 30 minutes. For uncoated tablets (which constitute 50% of all tablets in the market) machine efficiency may be reduced by more than 40% due to dust.
- **Pneumatic Discharge Flaps:** Most counting machines use pneumatic discharge flaps that frequently get jammed due to accumulated dust. Some systems offer no validation for the operation of these flaps, which eventually leads to miscounts.

- **System Setup:** In many multichannel machines there can be up to 32 parameters to be set by the operator, a time-consuming process which can result in inaccuracy due to human error.
- **Product Setup:** With traditional counting machines, flat tablets are problematic to feed and count, requiring a drastic reduction in machine speed. In many machines, 3mm width products cannot be counted.
- **Blind Spots:** All machines have blind spots, i.e. areas that are out of sight for the operator, where tablets can get stuck causing cross- product contamination upon product changeover.
- **Breakage:** In most machines, tablets reach the discharge unit in one piece only to break when falling to the bottle, causing unnecessary and costly breakage.
- **Reject Detection:** Many existing multichannel counting machines have no broken tablet detection capabilities, and those who do, use old and unreliable methods such as IR, OS or EFS resulting in very poor detection.
- **Bottle Rejection –** Existing machine reject counts as a whole, for example, when counting 200 tablets per bottle if the 5th tablet is detected as broken, the machine will continue counting to 200 and reject the whole bottle instead of the partial quantity, resulting in massive product loss.
- **False Rejects –** In order to maintain accuracy levels and due to machine uncertainties and counting limitations, existing machines are programmed to a high rejection level, causing many 'false' rejects. The outcome is a relatively high rejection level of 3%-5% not including broken tablets.
- **Counting Speed:** With most existing machines small counts do not enable increased counting speed, so a count of 30 and a count of 100 would be executed in similar rates.
- **Large Footprint:** In order to compensate for the need to separate the tablets, most machines use multi-channels, requiring a large footprint and massive maintenance.
- **Cleaning:** The cleaning process of a counting machine between changeovers typically requires dismantling and cleaning large sized contact parts which can take anywhere from 45 minutes to 2 hours!
- **User Interface:** Most counting machines are PLC-based systems, which basically mean less functionality (limited number of programs, types of tablets, no remote access, statistical data and user profiles) and unfriendly user interface. In some cases, there is no compliance to CFR 21.

To sum up the challenges: All traditional tablet counting solutions attempt to promise accurate counting, flexibility, high throughput and/or low-cost operation. None of them deliver on *all* promises. So what does?

**Vision-Based Bulk Counting Technology**

Vision-based bulk counting technology is the latest and most advanced innovation in the field of counting machines.

**How does it work?**

Vision-based bulk counting machines utilize advanced real-time image processing technology to enable highly accurate (100%) tablet counting and detection in bulk.

Instead of using several narrow tracks which carry one tablet at a time, the image processing technology uses one wide track to count multiple objects at once – hence 'bulk counting'.

This eliminates the need to separate tablets before counting, feed them one by one or space them at specific intervals. The result is 3-5 times the output per footprint.

The conceptual difference between this system and all other machines is that it was developed as a technological solution rather than a mechanical one. Counting is carried out by an advanced algorithm developed by a team of highly experienced multi-disciplinary professionals from the fields of electronics, optics, mechanics and computer science. This unique collaboration resulted in the emergence of the most advanced counting technology - 'bulk counting'.

The advantages of vision-based bulk counting are quite astounding:

**Benefits of vision-based bulk counting**

- 100% Accuracy: Vision-based bulk counting machines utilize advanced real-time image processing technology to enable highly accurate (100%) tablet counting and detection in bulk.*Most accurate machine in the market*
- **Small Footprint:** The invention of bulk counting, and the fact that there is no need to separate over multichannel, resulted in the *smallest machine in the market* in terms of footprint (L: 1200 W: 600 for 80 bpm machine,100 counts, 8mm).
- **Insensitivity to Dust:** The counting unit is separated from the tracks, which means significantly reduced dust accumulation. Once the dust accumulates on the counting unit, the system provides an alert. Cleaning takes no more than 15 seconds with *no need to disassemble* the counting unit which is not a contact part.
- **Magnetic Flap Connection:** The vision-based system incorporates a magnetic flap connection to minimize dust effects. Flap movement is achieved by a step motor enabling constant position and speed validation of the flaps.
- **Easy Cleaning and Changeover:** With the vision based system, all contact parts are designed for *tool-free* release in accordance with GMP design. The machine's small lightweight parts, the fact that the counting unit is separated from the track, and that contact parts regulation doesn't apply, resulted in the *fastest existing cleaning process*. By using a spare contact part kit, changeover from one product to the next can take

around 5 minutes, compared to 1 hour for old generation machines. Moreover, in-process cleaning is required only once in 8 hours and in extreme dust conditions.

- **Detection Capabilities:** The vision-based system provides accurate and automatic broken tablet detection. The machine can detect broken pieces as small as 0.5mm. Once a rejected tablet is detected (due to either breakage or size variation), filling of that specific container is halted and the container is immediately sent to the reject station, saving time and money. Other detection capabilities are size variations and overlapping detection
- **No Blind Spots:** The machine design enables the operator to observe each product unit from the hopper to the bottle, significantly reducing the risk of cross-contamination
- **Automatic Product Setup:** Automatic product calibration is performed when products are placed on a specially design calibration tool, and scanned by the camera. All tablet data (size, shape, etc.) is set automatically, resulting in a very simple and accurate new product setup procedure, avoiding costly human errors.
- **User-friendly PC Based Operation:** The vision-based bulk counting machine is operated through a color, touch panel PC based system. Both internal and external machine functions are controlled through a single HMI in an unmatched standard.