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**Authentix**  
The Authority in Authentication

**GEMVISION™**

**GemVision™ Camera System -  
Industry's First CD12 Fitness Solution**



## INDUSTRY'S FIRST CDI2 FITNESS SOLUTION

As the cash cycle continues to evolve, Central Banks are challenged to lower the costs associated with currency management while fighting new counterfeiting threats and improving the quality of circulating banknotes. The Authentix **GemVision™** Camera System is the industry's first CDI2 fitness solution. GemVision is powered by the Vision Inspector software solution developed by Boulder Imaging. The Vision Inspector solution allows for an unprecedented number of fitness related measurements to be made in a real time processing environment while operating on commercially available off the shelf Windows based servers. The high-speed (>404 banknotes per second), high-resolution (50-micron gray scale) imaging sensors and Image Evaluation Unit are designed in support of the new Common Detector Interface (CDI2) specification agreed to by the United States Federal Reserve Bank and the European Central Bank. This new standard allows for easy integration of 3rd party sensors into banknote processing systems.

This greatly helps cash visibility as it allows a Central Bank to select a fitness sensor with capabilities aligned to the fitness criteria that they value, whether it is accurate soiling determination, ink wear assessment on polymer notes or fitness determination of Level 1 features. Furthermore, the improved data access and direct control of note sorting provides Central Banks with the tools they need to increase cash cycle visibility. This CDI2 common specification also enables sensor fusion whereby results from sensors of multiple suppliers are combined to produce the best overall authentication and fitness decision for each processed banknote, bringing together ideas and solutions from various industry participants. GemVision provides unprecedented accuracy and speed for feature detection and fitness assessment of banknotes.



## GEMVISION DETECTION CAPABILITIES

- Detection of denomination, series and orientation of notes
- Multi-angle illumination and full color analysis for human-like fitness evaluation
- Industry-leading accuracy and repeatability for banknote evaluation results
- CD12 compliant image/data streaming for use by other sensors and storage of combined data for research, analysis and system enhancements over time
- High accuracy (>99.99%) determination of serial numbers and smaller printed characters



## GEMVISION BENEFITS FOR CENTRAL BANKS

- GemVision improves cash visibility by providing unprecedented access to banknote data and images acquired during high-speed banknote processing. This is significant to Federal Reserve Financial Services as it helps reduce the number of notes taken out of circulation prematurely.
- It increases the efficiency of banknote processing and extends the life of notes in circulation by making more intelligent sorting decisions regarding banknote authenticity and fitness.
- More intelligent banknote processing simultaneously reduces the cost of cash as well as its carbon footprint.

→ The CDI2 standard also makes it easier for Central Banks to optimize processing environments by selecting their detectors from multiple suppliers. The new standard is further projected to be adopted industry wide by most Central Banks over the next several years and will provide far greater control for the processing of banknotes and make it easier to select best in breed detection platforms in the future.



- It enhances fitness sorting and lowers the cost to manage cash by decreasing the rate of pre-mature shredding events. In addition, it provides central banks with improved access to the sorting decisions and the data behind these decisions.
- Enhanced note fitness assessment is driven by the sensor fusion and directly controlled by central banks regarding note sorting decisions. This enables central banks to assess the quality, wear and authenticity of banknotes with greater accuracy and precision. It empowers central banks to make more informed decisions regarding the circulation and withdrawal of currency, optimizing cash management strategies, maintaining the integrity of the currency supply and reducing the cost of currency management by lowering the rate of erroneous shredding of otherwise fit banknotes.



## THE MOST RELIABLE HIGH-SPEED FITNESS SENSORS FOR CASH PROCESSING

The **Common Detector Interface 2** standard was jointly created by the European Central Bank and the U.S. Federal Reserve. The U.S. Federal Reserve is the first central bank to specify the standard as part of its upgrading of the cash processing environment. This is part of an unprecedented overhaul of the cash processing operations.

A key part of the standard is the Camera Sensor and Fitness Solution. Part of the requirements focus on the note presentation and specify a “belt free view” which enable a higher level of fitness evaluation as compared to transportation approaches where the note is partially obscured by transportation belts. More accurate fitness determination leads to better visibility regarding the quality of notes in circulation. The highly accurate reading of serial numbers and series year information supports note fitness monitoring programs where the change in fitness of a note is evaluated over time. The improved access to sensor data and the sharing of data between systems will lead to more insightful analysis regarding note quality determination.

Authentix and **Boulder Imaging** collaborated with the specification groups within the ECB and FRB by providing feedback on the standards. This was important as key learnings regarding a new standard are typically revealed the first time systems are built following the new specification.

Authentix and Boulder Imaging also chose to go beyond the base requirements of the standard and to implement note image capturing techniques and image processing algorithms that make it possible to assess the fitness of overt features. This is particularly important regarding cash visibility as these are the features that the public most relies upon to confirm authenticity and fitness. Unless the quality of these overt features is being inspected, a central bank is not receiving a complete view of the quality aspects of a note that may impact how the note is used by the public and retail sectors.



## CAPABILITIES THAT EXTEND BEYOND THE CDI2 REQUIREMENTS FOR THE GEMVISION CAMERA SENSOR AND FITNESS SOLUTION INCLUDE:

- High resolution (100  $\mu$ m) full color images are captured at note speeds exceeding 10 meters per second (>40 notes/sec) that allow a high accuracy (less than 1 misread in 10,000 notes) of small text items such as the series year and intaglio plate letters and numbers. High-resolution images are also used to confirm the IR transparency of inks, the presence of windowed threads and resolve serial numbers and other text features.
- Balanced illumination is created by a pair of LED illuminators each at a precise angle to the plane perpendicular to the note motion. By capturing full color reflectance images using both balanced and asymmetric illumination, GemVision confirms the presence and activity of overt features. This creative imaging approach also determines if the quality of the overt feature has degraded over time and factor this information into the note fitness decision.
- Another unique innovation is detection of crumples and creasing on banknotes. The presence of shadows on GemVision images provides valuable information which can be used to determine the fitness of the note or the fitness of tactile features provided for the visually impaired.
- Novel scattering and shadow mask transmission images - GemVision relies upon a creative solution of using two types of scattering images to assess the fitness and authenticity of a banknote. A scattering transmission image is captured by the “back side” sensor housing while the balanced reflection image is captured on the “front side.” As the illumination is arriving on the note at an angle, the transmission image is created by light that is scattered forward into the collection optics. From these images GemVision confirms the presence of embedded security threads, paper “bridges” on windowed threads.



## USING NEXT-GENERATION TECHNOLOGY FOR THE MOST RELIABLE BANKNOTE SECURITY

- GemVision takes advantage of sensor fusion capabilities through the establishment of an Image Data Bus (IDB) to share images and a Data Machine Bus (DMB) to share denomination and orientation results made by the Camera System and its Image Evaluation Unit combined. This allows downstream sensors which require information such as the note denomination, orientation or series to receive this information from the DMB without having to generate an independent result. An aggregator module also supports sensor fusion allowing central banks to pool and weight multiple results from a collection of sensors to determine sorting decisions.
- CDI2 standard has not only disaggregated the sensor from the sorting machine but also disaggregated what was previously viewed as “the fitness sensor” into a Camera System and a separate Image Evaluation Unit. This means that entities with novel approaches to inspect a banknote or the analysis of the CDI2 images can choose where to focus using solutions like GemVision. Instead of providing a complete Camera System and IEU solution, they could target one or the other, either providing a new Camera System hardware design or connecting a device to the data buses to process the images that are shared with all sensors. This additional utility could replace an IEU or augment its results with additional image processing variables, potentially bolstering fitness results, authentication results and help Central Banks with complete cash visibility.



## CONCLUSION

With nearly 20 years of high-speed sensor development experience, Authentix is a trusted partner for central banks and understands the complexity of the cash industry. Similarly, Boulder Imaging has been helping industry partners solve challenging inspection problems for over a decade. The top capabilities of each organization helped to make GemVision and its unprecedented fitness measurement capabilities a commercial reality. The industry will benefit greatly as CDI2 fitness solutions like GemVision become the industry standard and consequently introduce new and innovative ideas for collaboration among multiple stakeholders in the cash cycle.

Please **contact us** to learn more and schedule a meeting with one of our currency experts.



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# The Most **Reliable** Banknote **Security** in the Industry



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