SOLUTION BRIEF

AI Machine Vision
Crop Disease Detection

Technology for Social Impact (TSI) Identifies Plant Diseases for Improved Crop Management

Solution built with Intel® Distribution of OpenVINO™ toolkit keeps farmers informed with AI visual inspection

TSI
Technology for Social Impact

For farmers, understanding and managing plant disease and pests can have a substantial impact on crop yields and output. Identifying the signs and symptoms of infestation or infection can be difficult. Now, TSI has developed a solution that uses artificial intelligence (AI) to visually detect disease.

The solution, built using the **Intel® Distribution of OpenVINO™ toolkit**, identifies nine potentially catastrophic pathologies in three crops: tomato, potato, and maize. Along with detecting pathological anomalies in crops today, TSI's road map calls for future versions of the solution to include integrated recommendation systems capable of suggesting specific pesticides and application rates.

Challenges: Overcoming adoption hurdles for agricultural producers

Human visual inspection of farm fields is an inconsistent process, and evidence of disease can be difficult to detect, especially for less-experienced agricultural workers. In low- and middle-income countries, farmers use large amounts of pesticides to avoid catastrophic losses, regardless of whether disease has been detected.

To improve agricultural productivity, disease identification is crucial. Most laboratory testing for crop diseases is time consuming. TSI discovered that in Bangladesh, most farmers skip lab testing in favor of precautionary use of pesticides regardless of whether disease is present. According to the World Bank, 51 percent of pesticides used in remote Bangladesh districts were classified as "very hazardous" and 19 percent as "extremely hazardous," with 47 percent of farmers found to overuse pesticides.[1]

90% disease detection rate[2]

The same study indicated that only 4 percent of farmers had received training on pesticide handling and safety, and 87 percent took no protective measures while handling pesticides. Due to the combination of pesticide overuse and a lack of safe handling, 26 percent indicated health impacts, including headaches, eye and skin irritation, vomiting, and dizziness.

For TSI, identifying disease faster than laboratory methods was critical to ensuring adoption, with an easy-to-use detection system that could prevent unnecessary pesticide application and reduce farmers' exposure to toxins.

OpenVINO™

Solution: Identification of plant diseases using TensorFlow and the Intel Distribution of OpenVINO toolkit

Using AI algorithms developed with TensorFlow and the Intel Distribution of OpenVINO toolkit, TSI developed a system capable of detecting diseases in maize, potato, and tomato plants. Overall detection accuracy is over 90 percent,[2] allowing easy use by both skilled farmers and nonexperts. Automated visual inspection is a fast process that allows detection of plant diseases when they are still in early phases and easier to treat. Today, the TSI system can detect:

Tomato
- Early blight
- Late blight
- Leaf curl
- Leaf mold

Potato
- Early blight
- Late blight

Maize
- Common rust
- Gray leaf spot
- Northern leaf blight

After a pathological anomaly has been detected by the TSI solution, the farmer is alerted with specific details of the plant disease. By limiting pesticide use to crops exhibiting pathological characteristics, farmers can reduce unnecessary use of toxic chemicals while maintaining healthy crops with high yields.

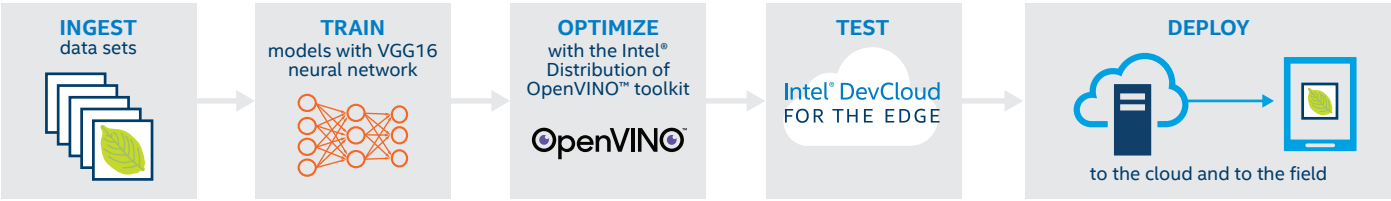
The solution can be accessed via an Android app on a mobile phone or tablet, for ease of use and portability directly into the field.

How it works in brief

To train the visual detection engine in their AI solution, TSI prepared a data set using high-quality, open source images depicting each of the nine plant diseases being scanned for. Images of healthy potato, tomato, and maize plants were also added to the data set.

Images were added with translation, rotation, and Gaussian noise effects to simulate the wide range of images that could be used in the field. Models were developed and trained using a transfer learning strategy with VGG16, a convolutional neural network architecture that improved prediction accuracy and was capable of identifying images that were not relevant to the solution.

After modeling, the solution was optimized using the Intel Distribution of OpenVINO toolkit, improving performance by 35 to 40 percent.[2] TSI optimized TensorFlow, Python, and OpenCV using the toolkit, and tested it using **Intel® DevCloud for the Edge**. This allowed TSI to test the solution in the cloud without buying physical devices or configuring the OpenVINO toolkit and to test the solution on several generations of CPUs, with the flexibility to optimize CPU cores and memory. TSI also used Intel® Core™ processors to test and optimize its AI models.



Conclusion: Automatic crop disease detection in the field powered by Intel® technology

Delivering the right amount of pesticide to the right field at the right time can reduce the overuse of chemicals and help farmers in low- and middle-income countries keep agricultural supply chains secure. Automatic detection of pathologies using machine vision and AI is an attractive alternative to human visual inspection of fields, which can be inconsistent and highly dependent on experience.

In order to effectively detect anomalies using visual images, TSI gathered data sets containing images of nine different plant diseases impacting three food crops. Images of each pathological condition, as well as of healthy plants, were used to create models using a VGG16 neural net. These models were then optimized and tested using Intel DevCloud for the Edge in conjunction with the Intel Distribution of OpenVINO toolkit. Using faster inference from the toolkit, TSI achieved disease detection rates of over 90 percent, even for the lowest-resolution images.[2]

Learn more

To discover how the TSI AI crop disease detection solution can simplify the detection of disease to reduce overuse of pesticides, email info@tsi.com.bd today or visit the project's GitHub page.

Intel Distribution of OpenVINO toolkit

The Intel Distribution of OpenVINO toolkit is free software for developers that accelerates performance, deep learning, and computer vision inference from edge to cloud. It supports heterogeneous processing and asynchronous execution across multiple types of Intel® processors.

Introducing Long-Term Support

Developers can now choose between standard support releases or Long-Term Support (LTS) for the Intel Distribution of OpenVINO toolkit. Standard releases provide new versions of the toolkit every quarter, ideal for early-stage projects and developers looking to take advantage of the latest innovations in deep learning. LTS offers long-term maintenance and support, a great choice for later-stage developers focused on leveraging the toolkit's existing features and functionality.

Long-Term Support benefits:

- Focuses on deployment and is designed to be taken into production
- Includes critical bug fixes for one year and security patches for two years, postrelease
- Enables shipping applications with reliability in existing capabilities and compatibility

Learn more ›

Intel DevCloud for the Edge

Intel DevCloud for the Edge is a cloud-based sandbox that empowers enterprise developers to test, prototype, and benchmark AI edge models across multiple platforms in real time, from nearly anywhere in the world. This makes it easy to identify the best hardware configurations for AI edge applications, accelerating time to market and reducing costs.

Learn more ›

About TSI

Technology for Social Impact (TSI) develops technology solutions for social impact in the areas of agriculture, health, and education. Based in Dhaka, Bangladesh, TSI is focused on innovation and application of technology to address real-life challenges in the developing world.

tsi.com.bd

1. http://documents1.worldbank.org/curated/en/203381468003337252/pdf/wps3776.pdf.
2. Source: internal TSI testing data.

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Intel® technologies may require enabled hardware, software, or service activation.
No product or component can be absolutely secure.
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