

Cardamom grading using Artificial Intelligence

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Lack of data transparency in production systems is a common phenomenon that pervades most food supply chains globally, more so in developing countries. In India, traditionally, mandi auctions for all food commodities have been devoid of technology and lacked transparency and efficiency. At the short end of the bargain, are smallholder farmers, whose incomes are directly affected by such shortcomings in the marketing mechanism.

Key words: Auction, Cardamom, KCPMC, Traditional method, Quality

KCPMC – Kerala Cardamom Processing and Marketing Company.

A man sympathized with the plight of the farmers all too well and aspired to transform the marketplace where he operated in Southern India. Mr. Jojo George is the Promoter and Managing Director of Kerala Cardamom Processing and Marketing Company (KCPMC).

KCPMC is an agribusiness company that, among other activities, both exports cardamom and owns an auction house at Idukki, Kerala. Its other products include rubber, spices, fertilizers and other agricultural products. KCPMC is the leading cardamom auctioneer in the country in terms of value and volume traded. Farmers from across Kerala and Tamil Nadu bring in their produce for weekly auctions, held every Thursday. The company also has collection depots at strategic locations for farmers' convenience.

Mr. George had a vision for KCPMC to transform into an efficient, transparent and, most importantly, an inclusive trade-exchange platform. His company had always strived to provide the adequate channels of marketing for farmers to ensure adequate farm income, in addition to supporting

them with farm inputs to boost productivity.

Traditional methods

KCPMC handles high volumes of cardamom and quality grading is paramount in priority. Before the auctions, the grading process relies on the experience and judging abilities of a few assayers and, therefore, prone to human subjectivity and error.

Similarly, before exports, the outgoing batches needed to have high levels of accuracy for the quality determination. This often required the traders/buyers to be physically present at auction site in order to assess the lots according to their own quality parameters. This limits the number of potential bidders on the

auction platform.

In addition to being subjective and inefficient, manual inspection method is also slow. With sampling, sieving and sorting, it takes more than 20 minutes to grade a typical sample of the spice.

Cardamom quality

Cardamom's price in the consumer markets, especially export ones, is highly sensitive to its grade. The spice is graded on the basis of size (girth), color and health of the pods. The size categories, with a range of 0.5 mm each, are: less than 6 mm, 6 mm to 6.5 mm, 6.5 mm to 7 mm, 7 mm to 7.5 mm, 7.5 mm to 8 mm and greater than 8 mm.

For testing, samples are drawn randomly from a farmer's incoming lot. These samples are mixed thoroughly before further drawing a



Fig. 1. Cardamom auction underway at Idukki

Source: Spices Board of India



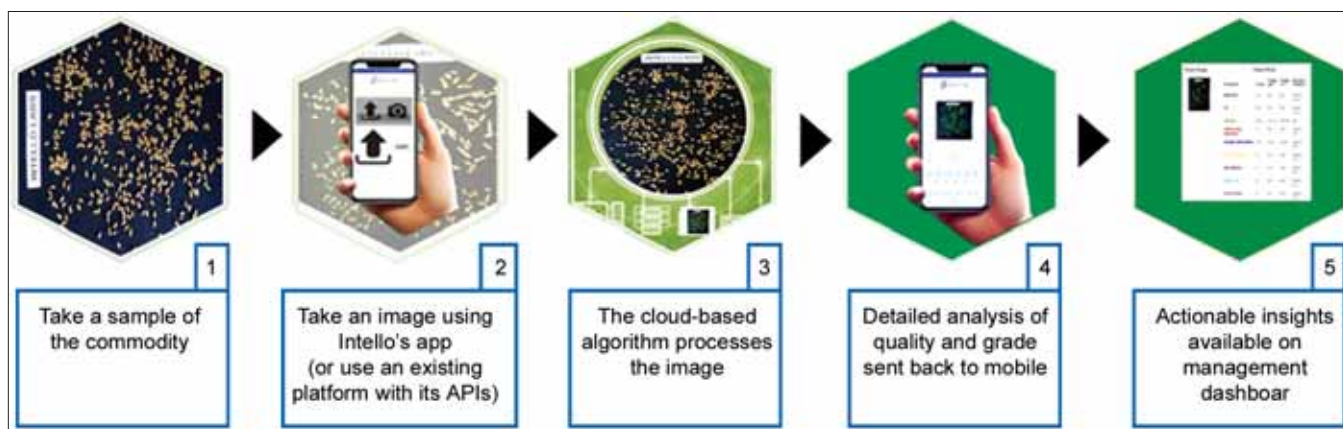


Fig. 2. Chain of AI in detecting Quality Cardamom

smaller sample of 100-500 grams to grade the lot. This sample is first sorted on the basis of pod size using sieves or sorting machines. Next, the sample is visually observed by designated Quality Inspectors to account for color distribution and shape anomalies, if any. This process is highly subjective and prone to discrepancies among the quality reports generated by even experienced inspectors.

The total traditional sorting and grading process takes about 20 to 25 minutes.

Intello Labs

Mr. George came across Intello Labs at World Food India 2017, a high-profile agri-food event organized by the Government of India. At the same event Intello was awarded the prestigious 'Startup in Agri Award' by the Hon. President of India.

Intello is working with some of the leading global agri and food companies across food categories.

At the time, Intello had just successfully concluded a project for the Government of Rajasthan to help wheat farmers quality inspect their harvested produce before the sale to traders – using just an image-based mobile app. With KCPMC's support and expertise, Intello started to explore an image-based grading solution for cardamom.

In addition to cardamom, Intello's suite of commodity solutions includes tomatoes, wheat, strawberry, while several others are under active development.

Intello Labs' image-based

solutions use Computer Vision and Deep Learning tools to provide quality monitoring and grading solutions for participants in the agriculture and food industries. At the simple click of an image, the user – a farmer or a warehouse employee – can objectively determine the physical composition of a commodity sample within seconds or minutes. Additionally, the quality data is shared in real-time across the supply chain and the organization, bringing standardization and scalability without any capital expenditure on the part of the food company.



Solution

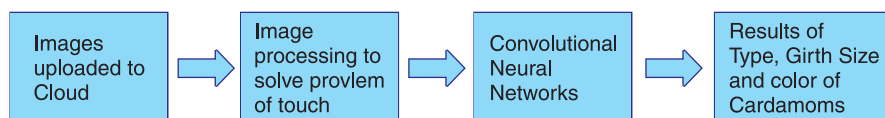
Intello ventured out to develop a solution to digitize the quality and grading process at KCPMC using its proprietary AI. The solution replaced the manual inspection methods with an image-based classification of samples. The AI identifies each pod in the image and classifies it on the basis of size, color and health. The results of all the pods are then aggregated to determine the final quality grade of the lot. The process takes just about 40-55 seconds, depending on the sample size.

From an end-user standpoint, a KCPMC employee clicks an image on her smartphone using Intello's app. The image is processed by our cloud-based AI to generate almost-instantaneous quality report. The data can be shared with any stakeholder through an online dashboard.

Technology

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Intello's solution uses various proprietary Convolutional Neural Network (CNN) layers to perform various tasks on an image, such as object identification, detection of specific markers and classification of identified objects into various quality categories. It also combines multiple architectures across stages and leverages traditional image processing and machine learning techniques to provide the best results across different deployment scenarios.

Intello's solution primarily uses an open-source technology stack, which renders it scalable. It leverages platforms, such as TensorFlow and OpenCV, for computer vision – typically using Python and its multiple libraries. Ruby on Rails serves as the full-stack engineering platform to develop backend and frontend solutions that serve customer business teams. Further, it uses Java to deliver mobile apps to end users, such as warehouse employees and field agents.

Implementation

KCPMC helped Intello Labs to collect cardamom samples of various sizes, color and health. Over the period of two months, physical samples as well as their images were tagged by KCPMC experts and shared with Intello Labs for training of the computer vision algorithm.

The prototype solution was deployed to establish a proof of concept. It was tested out for six months in live conditions and results corroborated against lab results on the actual quality parameters.

The end-to-end solution was developed and implemented within a span of four months.

Outcome

After a satisfactory completion of the pilot project, Intello's solution has now been deployed at KCPMC's facility. All purchased lots are assessed for quality and traders are given feedback on their purchased lots as well as the deviations from the quality they had perceived.

Within a matter of months, the accuracy level of the solution reached

95% and is constantly rising – as compared to a previous 70% for the manual results.

With subjective, time-consuming and inefficient manual grading process gone, KCPMC expects to be able to handle much larger volumes and reach out to more traders during the auction process, and the need for everyone's physical presence at the auction house will be eliminated too.

Testimonial

Mr. George has been more than satisfied with the results and is enthusiastic about the disruption to the traditional marketplace model, at least as far as cardamom goes.

“The single most defining element in the industry today is the multiplicity of grades that exist and the physicality involved in assessing grades by buyers... With the Intello's solution we hope to eliminate the requirement for traders to be physically present to assess grades where the defining factors are size and colour of the commodity.

This will revolutionise the buying process in cardamom and will [help us] include a large number of buyers.”

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Workshop on AI in ICAR

National Workshop on **Artificial Intelligence in Agriculture** was held on 31 July, 2018 NASC Complex, New Delhi.

Introduction

Artificial Intelligence (AI) is a stream of computer science that attempt to develop intangible system which not only behave intelligently but also display behaviour to the same level as human being think and act, achieving human-like performance in all cognitive task using purely logical reasoning. AI is intelligence demonstrated by machine, in contrast to the natural intelligence displayed by humans. AI is the automation of the activities one can associate with human thinking, like speech recognition, natural language processing, decision making, learning etc., which will make system (including Computers) powerful and useful. AI can use to create intelligent system which can also be embedded in machine that can work with higher accuracy and speed and at the same time be responsive like humans.

Objectives

- ✓ To discuss various plausible AI based application in agriculture and development.
- ✓ To explore the possibilities of incorporating AI based system in potential area of agriculture.
- ✓ To provide platform for agriculture scientist to deliberate on Ai and its implementation in agriculture.

Issues discussed in following Technical Sessions

Session 1 : Industry initiative in Artificial Intelligence.

Session 2 : Robotics/ Intelligence Farm Machine.

Session 3 : IoT/ Wireless Sensor Intelligence/Smart Farm. Drone Technology.

Session 4 : Image Processing.

Session 5 : Block-chain Technology application in agriculture.

Session 6 : Deep learning/ Machine learning/AI based adoptive E-learning system.