Contaminated Corn Detection and Removal System

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PROBLEM STATEMENT:

Fusarium is a fungus that infects grain species such as corn, leaving behind a mycotoxin called DON (Deoxynivalenol). When DON is ingested by livestock, the result is weight loss, feed refusal and reduced growth; all of which are disastrous results for farmers.

Current method of DON detection involves testing a small representative sample in laboratories. Unfortunately, there is no removal or cleaning system implemented in the corn supply chain.

Healthy kernels | Infected kernels

PROPOSED SOLUTIONS:

- Precise machine vision tools and software used for identification of DON infected kernels.
- Custom fixtures designed to position and sort kernels using gravity.
- Identification and removal accuracy > 95%.
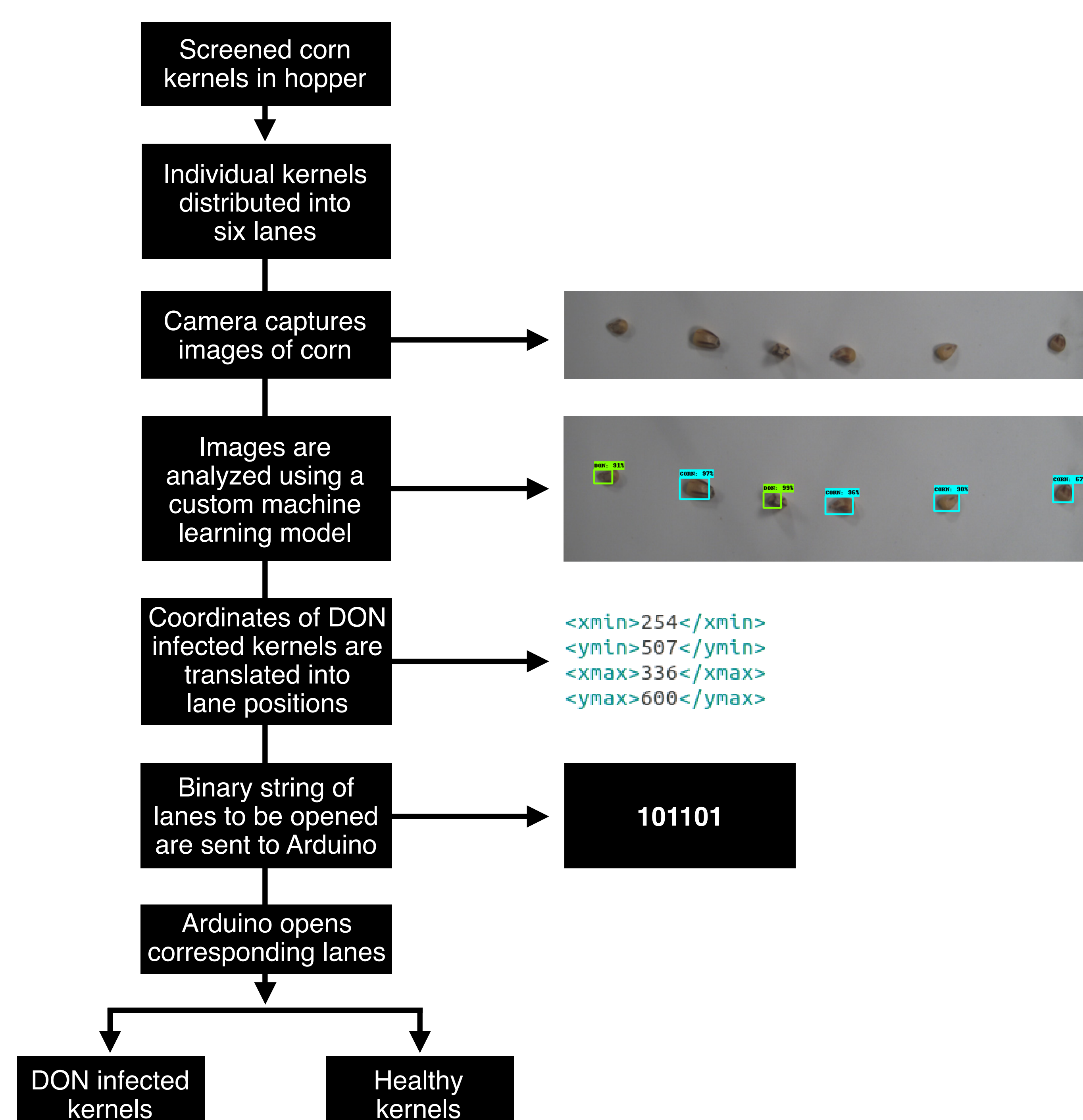- Scalable prototype that can be used in industry.

1. Kernel Metering Hopper
2. Camera
3. Ejector
4. Servo Motors
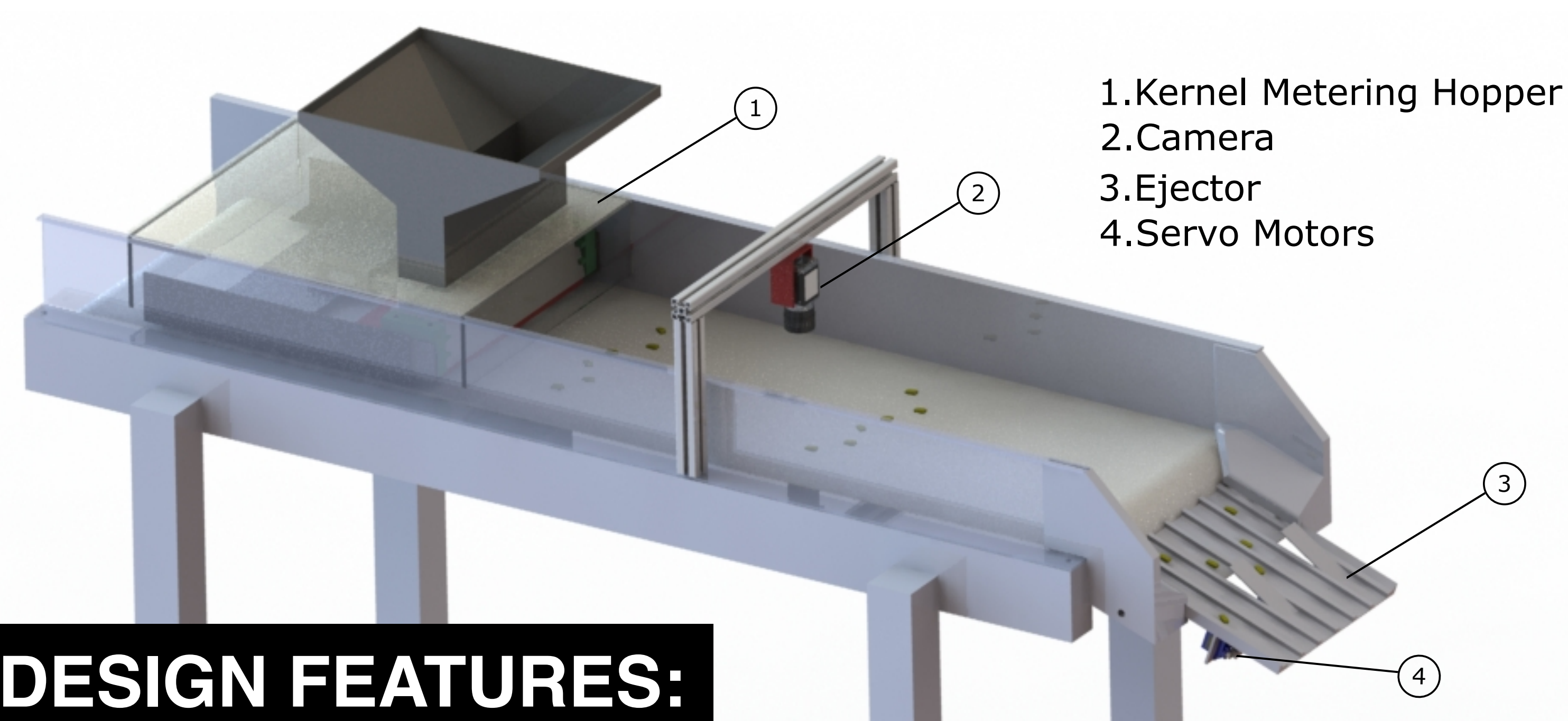
DESIGN FEATURES:

Mechanical: Kernel metering hopper and ejector mechanism 3D printed using biodegradable and food safe filament known as Polylactic Acid (PLA).

Electrical: System requires six servo motors, one linear actuator controlled by Arduino Mega 2560 & DFK 33UX178 high resolution camera mounted flawlessly to an industrial food-grade conveyor belt.

Software: Predominantly written in Python, it analyzes camera images and identifies lanes corresponding to infected kernels. The Arduino receives lane information from the Python program opening the ejector gates using a servo motor.

Screened corn kernels in hopper

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Individual kernels distributed into six lanes

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Camera captures images of corn

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Images are analyzed using a custom machine learning model

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Coordinates of DON infected kernels are translated into lane positions

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<xmin>254</xmin>
<ymin>507</ymin>
<xmax>336</xmax>
<ymax>600</ymax>
```

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Binary string of lanes to be opened are sent to Arduino

101101

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Arduino opens corresponding lanes

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DON infected kernels   Healthy kernels

FUTURE WORK:

- To make this machine accurate with a wide variety of corn strains and different contamination levels; additional images would need to be gathered to create a larger set of training images.
- A higher flow rate is required in commercial applications of this technology. More lanes would be configured in the future designs to reach desired flow rate demanded by Ontario farmers.