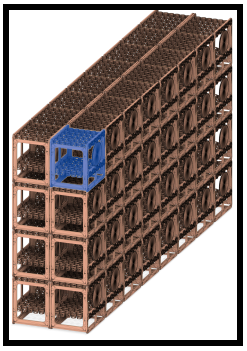
OvaVision Technologies: OvaVision Incubator (ID: 57072819)

Introduction: As children, our team members were fortunate enough to experience the joy of incubating and raising quails. However, we sought only their eggs and we experienced first-hand **the challenge of distinguishing between male and female** quails. We were often frustrated by the presence of male quails, which contributed to noise pollution without adding to our egg yield. This personal struggle mirrors a **larger, industry-wide issue** in poultry farming. The inability to pre-determine the sex of poultry leads to production inefficiencies and economic losses. In many egg-laying operations, male chicks are culled as they cannot produce eggs or grow sufficiently for meat production, raising both ethical concerns and resource wastage. To address this, our team developed the Ovavision Incubator, an automated egg-sexing incubator that revolutionizes poultry farming by identifying the sex of eggs before hatching. This humane, efficient solution reflects our personal experience and resonates on a global scale.

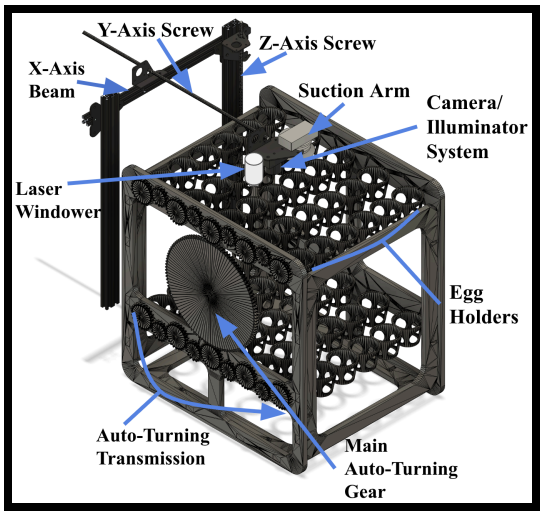
Problem Statement: The culling of over 6 billion male chicks annually highlights a significant ethical and economic dilemma. The standard practice of culling day-old male chicks, which are neither viable for egg production nor meat sales, not only raises ethical concerns but also leads to considerable resource wastage, with approximately 50% of hatchery space occupied by chicks destined for culling. Current in-ovo sexing research seeks to solve this, yet existing methods like DNA analysis and optical spectroscopy are invasive, costly, or inaccurate, particularly for darker-colored eggs. Recent advancements, such as Jia et al. 's (2023) machine vision-based blood vessel detection, offer promise with up to 90% accuracy in early-stage sex identification. However, these methods are mostly confined to laboratory settings and face challenges in recognition accuracy and applicability. OvaVision aims to enhance these methods and provide a practical, ethical solution for the industry.

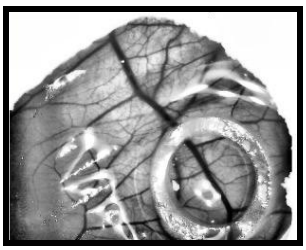
Innovative Solution & Technology Description: The OvaVision Incubator is a modular system



that streamlines the sexing and incubation process and introduces a level of precision and care previously unseen in poultry farming. Each egg receives automatic turning, laser windowing and dedicated illumination, optimizing visibility for the subsequent imaging process. The system's camera, laser, and extraction rail, though not visible in the 64 module render (left), are integral to its operation. Highlighted in blue is 1 module of the incubator, which can be configured by hatcheries purchasing our incubators to fit their spatial/output constraints.

Laser Windowing: Before imaging and analysis of the vasculature, a laser diode is used to create a 12mm window into the egg above its aircell, without penetrating the inner membrane. Unlike any current methodology for in-ovo sexing, our technique leverages the non-invasive window to capture better imaging of blood vessels to enable more optimized sex detection using deep learning models trained to correlate blood vessel development with chick sex. **Imaging and Analysis:** On day 3-4 of incubation, the camera/extraction rail system captures high-resolution images of the developing blood vessels within the eggs. These images are processed in real-time using advanced deep learning algorithms that determine the sex of the embryo with remarkable accuracy. **Automated Sorting and Removal:** Upon identification, a precision-engineered suction arm engages, gently removing male eggs from the





Chicken air-cell membrane as part of exploratory research of air cell windowing on vascularization imaging

system. This selective removal process ensures that the growth of female embryos remains uninterrupted and grouped by age for optimal development. **Efficient Incubation Layout:** The OvaVision system prioritizes the incubation of female eggs at the topmost layers of the incubator. The bottom modules of an array of incubators serve as the input tray for new eggs, ensuring a constant cycle of incubation and sorting.

Unique Value Proposition: The poultry industry faces challenges with resource waste and economic inefficiency due to chick culling. Current solutions, like those from In Ovo and Seleggt, are limited in scope and involve invasive methods or are region-specific, leading to economic inefficiencies for hatcheries. Our OvaVision Incubator addresses these issues by offering early, minimally invasive sex detection integrated into the egg incubation process.

Business Model and Economic Sustainability:

a) ***Prototype Development:***

OvaVision has prototyped an incubator module using scrap parts from broken incubators, and household appliances. The prototype demonstrates auto-egg turning and has a tempered glass top panel to allow clear imaging of eggs within the incubator. Within the next 2-3 months, we expect to create a 3-axis rail system with a multi-field imaging system, in order to capture blood vessel images in bright & dark fields, after which we will train a neural network for sex detection.

b) ***Production Costs***

The injection molds required will sum to **$25,000**. The cost of ABS plastic needed to mold each module is **$2.60** (~2 lbs of ABS plastic per module at $1.30/lb). We will attach a labor cost of **$5.00** per module. If we manufacture 100,000 modules, the price of the total plastic components will be 100,000($5.00 + $2.60) + $25,000 = **$785,000**. This means that the price of the plastic per module will be **$7.85**. Each module will also require a 25 kg high-torque servo motor for

rotating the eggs, which costs **$15.00**, making the fixed price of each module **$22.85**. Each total system, however, will also take on the cost of all the electronics required to make it function. A 5 megapixel camera with up to 1,000x magnification will cost **$100**, 5 stepper motors for the rail system costs **$75** total, an Arduino microcontroller to control the servos will cost **$20**, a stepper controller with integrated drivers will cost **$60**, a windowing laser costs **$40**, and an egg suction arm will cost **$20**, totalling **$315** for all of the electronics. We can hereby estimate the cost of any OvaVision incubation system based on the number of modules being used. For example, a 64-module system like the one pictured above will cost 64 * $22.85 + $315 = **$1,777.40**. A 64-module system will support the incubation of 64 * 60 = **3,840 eggs**.

c) Market Size

Our OvaVision Incubator seeks to revolutionize the rapidly expanding United States poultry industry, an international leader in the red meat space, due to the presence of competitive production networks, abundant resources, and a robust consumer base. According to the U.S. Department of Agriculture, total sales equated to $76.9 billion in 2022, growing 67% from 2021, with a current market size of $40.02B projected to reach $42.67B by 2029.

Our **Total Addressable Market (TAM)** will include all North American poultry farms/hatcheries, ranging from small-scale family farms to large industrial hatcheries. There is no conclusive data on the total number of North American poultry farms, so we estimated there to be at least 200,000 farms. If every consumer buys 5 incubators, this means that the TAM will be **$5,000,000,000 (**200,000 ***** ($5,000*****5))**.** Our **Service Addressable Market (SAM)** will include all US poultry farmers and hatcheries, which totals to about 164,099 farms as of the latest census. This means our SAM will equal **$4,102,475,000** (164,099 farms * $25,000)**.** Our **Service Obtainable Market (SOM)** is all small hatcheries in the US (25,000 family poultry

farms). If we assume our market share in our first year will be 1%, then our SOM will be **$41,024,750 (**0.01 * 4,102,475,000).

d) Revenue Model and Profits:

We are planning to implement a **business-to-business (B2B) model**, aiming to sell our incubators at $5,000/64-module incubator unit to poultry farms and hatcheries. The production cost of one incubator unit including molding, injection materials, and labor expenses totals to **$1,777.40**, as mentioned in volume production. We aim to sell **2,000** units in one year, totalling production costs to $3,554,800/year. Accounting for operating expenses, current New Jersey industrial manufacturing rent **($8.38ft²/month)**, we estimate a 1,000 ft² factory will cost **$100.6K** per year. If we reach 2,000 units sold, our revenue totals to **$10M/year**, leaving our yearly profit to be **$6.3446M/year** ($10M - $3,554,800 - $100,600) with Net Profit Margins at **63.45%**.

e) Market Expansion

In the next five years, our plans include developing an OvaVision Incubator product line and initiating pilot programs with hatcheries for real-world testing and feedback. Collaboration with industry organizations like the U.S Poultry & Egg Association and research institutions will also further enhance our credibility and advance our product. To broaden our reach, we aim to analyze and customize marketing strategies for significant poultry markets like China, Brazil, and India, establishing connections with local government bodies and agricultural associations.

Our (Ova)Vision: Our mission is to transform the egg-farming industry with the OvaVision Incubator, making incubation more efficient and sustainable. This innovation allows hatcheries to selectively eliminate male chick eggs from incubation itself, saving space, resources, and money. Beyond financial benefits, OvaVision promotes ethical hatchery practices, contributing to a morally sound future for the egg industry.