SIMPLE INTELLIGENCE

Pursuing the next generation of robotics.

Introduction

Every two seconds, someone in the world dies on account of poverty-related issues. The greatest portion of these deaths is due to an inefficient supply of food. Most people think of Africa, India, and other third world regions when referring to poverty, however poverty is a greater issue in America than most people realize. According to National Center for Law and Economic Justice, 46.5 million Americans live below the poverty line. Currently the only two viable measures to deal with the issue of poverty is to expand farm land or increase the total food output of existing farms to supply more food. By using simple but innovative robotics, we can provide farmers an ecofriendly way to increase production without harming the environment.

Problem

The main problem with modern food production is the amount of crops that are wasted. With high poverty rates, every small amount of food wasted could mean someone's life. Based off of this main problem, there are several factors impacting the need for increased food production:

- Food supply must increase 70% by 2050 in order to combat the worlds growing poverty rate.
- Current methods of crop production are not efficient enough to sustain this level of population growth.
- Pests, mainly birds, eat 12% of crops which cause respective farmers to lose billions of dollars each year.

Solution

At *Simple Intelligence*, our team of engineers and computer scientists are in the process of developing an autonomous quadrotor to decrease the quantity of crops lost to birds. We are working to adapt and expand autonomous flight technology to operate in an agricultural based environment. Currently this technology is not used on a large scale to deter birds because of their

limited flight times. Our quadrotor deals with this issue by autonomously replacing its power source. We also dramatically increase our range of flight by using GPS and optics to track and locate different stations. These stations will proceed to automatically remove depleted batteries and replace them with fully charged batteries. Our goal is to remove the human element of servicing the quadrotor which in turn will decrease the amount of labor required. Compared to traditional quadrotors, our quadrotor will be more suitable to perform in agricultural.

First prototype: Using 3D printed pieces and aluminum sheets we were to see and test our ideas.

Current Pest-Deterring Methods

There are several methods that are being used to increase crop production. All are effective to some degree, but more technology is desired to further reduce losses. Current methods are:

Spraying Non-Lethal Chemicals

- Many farmers spray chemicals on crops that repel birds.
- This has been shown to increase crop production by around 15%.

Netting

- Farmers will wrap nets around their crops, making it more difficult for birds to eat said crops.
- Netting is viewed to be the most effective method to reducing crop loss to birds.
- Netting has high front end costs as well as high labor costs.

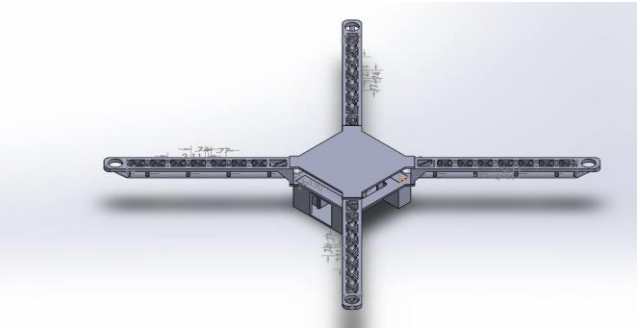
Other Attempts

- Shooting birds, which is illegal for certain species.
- Sounds and lights, which is not effective.

Benefits of Quadrotors over Other Methods

With several other methods for increasing crop production already being used, some may argue that a quadrotor isn't suitable for agriculture. However, our quadrotor has several benefits that extend beyond the benefits currently in use. First, this device has low maintenance since it can automatically switch out its batteries in less than 30 seconds. Second, our device is relatively cheap. At only around $600 to buy and less rent it is much cheaper than methods currently in use. Netting crops is expensive in front end costs, due to material costs and labor, making it less efficient. Finally,

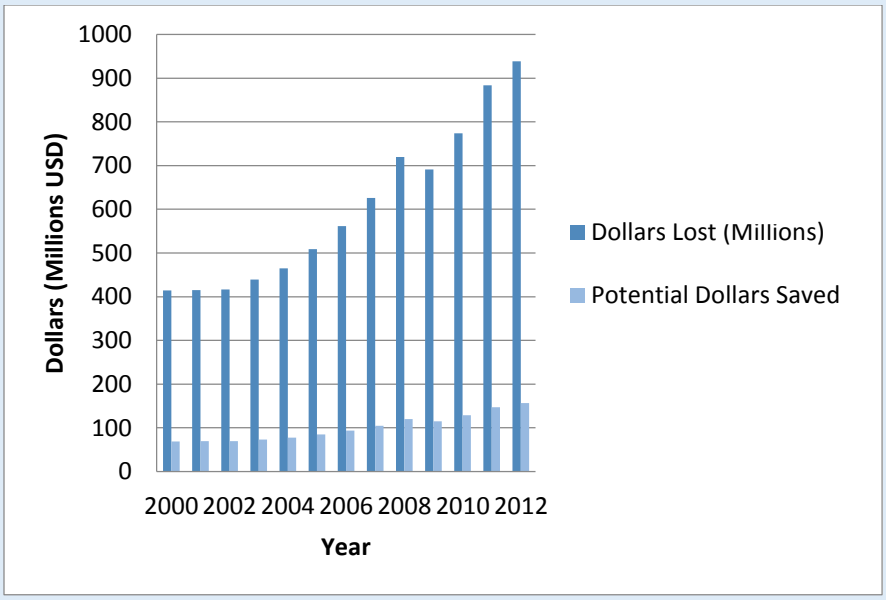
the *Simple Intelligence* quadrotor can be simultaneously combined with existing methods to maximize profits.



Designed in Solidworks. Alan Vandegrift developed ideas on how to best produce an aerodynamic frame.

Scope of Opportunity and Global Impact

We often tend to turn a blind eye to problems regarding hunger and poverty in the world, but the sad fact is that poverty is a much bigger part of our world than we would like to admit. Approximately 27% of children in developing countries are grossly underweight, and roughly 3 billion people worldwide live in poverty. However, this is not just an international issue. The current poverty rate in the United States in around 15%, and the *lowest* this rate has ever been in the last 50 years is 11.1%. Poverty is an issue that impacts a wide range of Americans. Of these families receiving food stamps, 76% contain a child, an elderly person, or a disabled person. Due to the fact America exports around $130 billion amount of food to other countries, decreasing poverty rates domestically will in turn decrease poverty rates internationally. As the price of food falls, it will become available to more people. Greater food supply will lead to larger quantities of food for those impoverished.

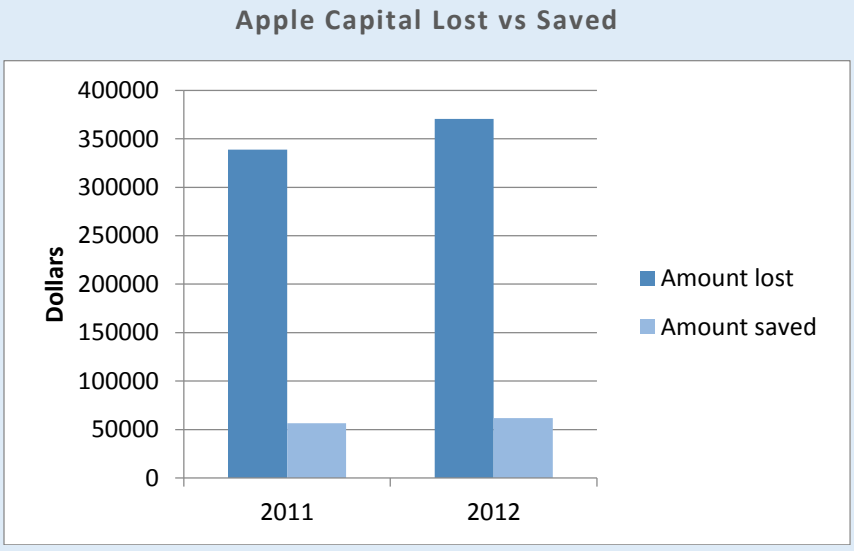


The above figure shows the amount of money that is lost due to birds and other pests eating 12% fruit that is going to be exported. Over the last 13 years, the U.S has lost $7.5 billion to pests, the majority of them birds. If around 16% of these crops had been saved, lowering the rate of crops lost to 10%, then U.S food producers would have saved $1.39 billion over that same 13 year period. The most influential impact of saving this many crops would be the increase in world's food supply. A larger supply would lower costs for consumers in other countries, helping to lower poverty rates.

Market Opportunity

Every year that passes is hundreds of millions of dollars lost, making now a better time than any to launch our quadrotor. In 2012, United States apple producers lost around $370 million due to of preventable losses to pests. Dr. Javier Calvo-Amodio reports that $80 million is lost from cherry, grape, honey crisp apple, and blueberry farmers per year in Washington State alone due to birds. Farmers are willing to pay for improved technology to deter birds and increase their revenue.

One of the most important aspects to farmers is an output that they can count on. Farmers simply cannot lose large amounts of money to birds each year without seriously jeopardizing their liveliness. Unfortunately, there are cases where farmers considerably more money than they expected due to birds. *Youngbird Hill Vineyards* reported that in 2010 they lost over 50% of their crops due to unexpected birds. This does not happen often, of course, but when it does farmers need a method to avoid losing painful amounts of money. Farmers recognize this which increases our market for the product. Food production will continue to grow over the next twenty years which will only increase market opportunities.



The above figure shows the amount of money that is lost due to these birds and the amount of money that could be saved due to only a small increase in production. By reducing the amount of crops lost to only 10%, U.S farmers will save around $61 million per year (based off 2012 production levels). That is a huge potential for increased revenue giving more farmers incentive to buy our product.

Financial Outlook

We plan to offer two different ways to use our quadrotor. First, a customer could buy the product for an estimated cost of $600. Second, the customer could rent the product on a monthly or yearly basis. Of course, renting would be cheaper for customers who are looking to only use the product during growing season while buying would be for long term use. Using our quadrotor we could save farmers thousands of dollars per year depending on the size of the farm. These savings will exceed both the $600 investment cost and the cost of operation. Due to these savings, farmers will be able to turn a profit with this product in under one year.

Cost of Materials

Board and Software	$100
Quadrotor	$70
Base	$120
Labor	$50
Total	**$340 per unit**

Plan to Manufacture

Total Units	200
Price per Unit	$600
Units Produced per Month	40
Full Return in:	5 months
Per Month Expenses	$13,600
Expected per Gross Month Revenue	$24,000

Summary

Total Expenses for first 200	$68,000
Total Revenue from first 200	$120,000
Total Profit	52,000

Startup Cost for 200 copters

$68,000 total

Group Members

Lorin Vandegrift is an undergraduate at the Washington State University studying computer science and entrepreneurship. He has experience being part of two startups thus far and plans to pursue his own startup in the field of robotics. Lorin has worked in research labs at the University of Washington and Washington State University focusing in different areas involving robotics.

Alan Vandegrift is a senior at Washington State University studying mechanical engineering. He aspires to enter the green energy sector, focusing on wind turbines. He has worked on the SI team since the group was established. Besides engineering, Alan is also involved with the local school theater club, Improv Ground, and has been in several other productions.

Dustin Crossman is a junior at Washington State University studying Computer Science and minoring in Philosophy. He comes from Vancouver, Washington where he spent many years rowing and enjoying the outdoors. He is the lead software designer for SI.

Cameron Mehl is a junior at Washington State University studying Computer Engineering. With his experience in both Electrical Engineering and Computer Science, he is a key member in integrating hardware and software. His passions include coding and electrical projects in his free time, go karting when he is by the track, and working on his car.

Mitchell Scott is an undergraduate student at Washington State University studying Mechanical Engineering and Economics. Being a part of the WSU robotics club and working with economic professors he has obtained knowledge pertaining to the development and distribution of robotic systems.

Gabriel de la Cruz is a PHD student at Washington State University studying computer science. Gabe is a first-generation immigrant, who was born and raised in Cebu City, Philippines. In 2005, he earned a bachelor's degree in Information Technology in Cebu Institute of Technology. In the same year as his graduation, he immigrated to United States, and 5 months after served in the United States Navy. His research focuses in the field of Artificial Intelligence, more specifically in Reinforcement Learning, Transfer Learning, and Multi-Agent Systems and their application to robotics.

Kyle Florek is an undergraduate at the Washington State University studying mechanical engineering. Kyle is a true engineer at heart, having experience in not only mechanical engineering, but electrical engineering and computer science as well. He has an abundance of hands on experience designing and building different projects in and out of the area of robotics.

Scott Olivares is a senior at Washington State University. He transferred from Central Washington University to pursue a dual degree in physics and mechanical engineering. Scott's background in physics contributes to aerodynamics of the project's designs.

Advisors

Matthew Taylor, PhD, is currently an assistant professor at Washington State University in the School of Electrical Engineering and Computer Science and is a recipient of the National Science Foundation CAREER award. Current research interests include intelligent agents, multi-agent systems, reinforcement learning, and transfer learning.