Product Plan for Anti Predator Device

Introduction:

We propose a plan of development for an electronic device used to deter predators from entering areas containing livestock. First the existing problem is explained. Next the locations and potential markets are discussed. Finally a strategy to develop prototypes is given.

The Problem:

There has been a 90% loss of the African lion population during the past 70 years. According to Dr. Shivani Bhalla, director of the Ewaso Lions Project, in Kenya alone only around 2000 lions are still alive. Currently lions are disappearing at a rate of 100 per year. This drop is primarily due to habitat loss and contact with human pastoralists and their livestock. Similar problems exist with other carnivores as well, such as hyenas. Lions in northern Kenya are especially vulnerable to conflict because they live in or adjacent to areas inhabited by nomadic pastoralists and come into regular conflict with local people over livestock depredation. Conflict occurs when lions attack livestock and herders retaliate by fatally shooting, spearing, or poisoning lions and other large carnivores.

Other locations are experiencing the same issue. Throughout the plains of central Asia Snow Leopards are attacking domesticated livestock and end up dying by the hands of human herders. Complacent guarding, poorly constructed night-time pens, favorable stalking cover and insufficient wild prey all contribute to livestock loss. Loss rates of snow leopards vary widely from less than 1% to 3%, but the annual economic impact of livestock depredation may range from $50 to nearly $300 per household. This is significant given annual per capita cash incomes of $250-$400. Herders are especially angered by events of surplus killing when a snow leopard enters a corral and kills up to 50 or more sheep and goats in a single instance. Herders naturally want to retaliate by killing the offending cat. In a very real sense, such livestock represent each family's primary "bank account." While such corrals can be physically predator proofed (by constructing higher and more study walls with roofing), the cost of obtaining such materials (wire mesh, sturdy fence posts, etc.) is high, especially in the Himalaya where all supplies have to be transported by horse or yak in light of the rugged terrain and few roads. It could cost $3,000–5,000 to predator proof a pen large enough to contain animals belonging to as few as 5 - 20 households. The use of solar electric fencing offers some savings, but predator proofing the many thousands of night time pens even only those within select parts of the snow leopard's vast range would be prohibitive.

Conflicts between traditional livestock herders and wild predators have escalated sharply in recent years, resulting in retaliatory killing of lions, leopards, hyenas, snow leopards and wolves in many parts of their respective ranges. In Kenya lions approach thorn brush corrals, roar loudly, then attack the frightened cattle, sheep or goats belonging to Masai or Samburu herders as they break through the flimsy boma structure. Therefore, there is a need for less costly interventions for addressing this important threat to the long term conservation of large predators, especially given the constantly shifting spatial and temporal patterns of depredation. While there are several devices on the market (e.g., *Predator Guard*, *Niteguard*, *Foxlight*) which emit regular flashes of light throughout the night, researchers believe it is highly likely wildlife would habituate if such systems were active night after night.

A smarter, more cost effective device is needed in the field immediately. A call for an electronic predator deterrent was issued by Rodney Jackson and Paul Thomson outlining desired features for a new device for use in the field in Northern Kenya as well as in the Himalayas. Our challenge is to meet or exceed the design specifications presented, while leveraging our knowledge gained from our own field testing and our exploration of the value of existing products on the market.

Testing Locations and Potential Markets:

During the Alpha testing phase, the Anti Predator Device will be deployed first locally in the Santa Cruz mountains of California, followed by a Beta testing phase in northern Kenya, specifically in and around the Samburu National Reserve, Buffalo Springs Natural Reserve and other locations monitored by the non-profit organization, Ewaso Lions. Eventually, additional testing will occur in the Snow Leopard Ranges central Asia where the Snow Leopard Conservancy group is currently testing Foxlights, a useful but less robust solution that is already in the field.

Aside from filling the immediate need for a predator deterrent, our device has a large potential for eventual use domestically and use abroad as a general deterrent for both unwanted carnivores and herbivores. Examples include home garden protection. Chicken coop protection, crop protection among many others.

The Solution Approach:

We aim to develop an inexpensive, rugged, and effective predator deterrent with an intelligent micro controller and thoughtful design. Our prototype device will make use of a wide angle passive infrared motion sensor with matching Fresnel lens. The sensor will have a range of up to 50 feet and have user selectable high and low sensitivity levels. Responses to motion detection over defined time intervals will lead to different combinations of flashing LED lights and sound emission.

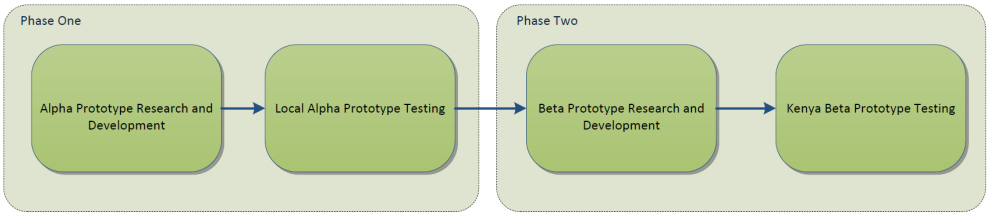
Visual Stimulus – An array of ultra bright LED's will blink in predefined, non habituating patterns upon predator detection and automatically at set intervals during the night. Multiple colors and time interval patterns will be tested locally to discern the most effective temporal light and color combinations.

Auditory Stimulus – Sound will be coupled with the visual stimulus to further ward off potential predators. The sound may be turned on/off by the user. Local field testing will evaluate the use of piezoelectric alarm noise, recorded human voice tracks, recorded gun shot sounds, as well as ultrasonic sounds known to deter cats.

Smart escalating warning patterns will be implemented. These patterns will be guided by data gathered in our local field test. One example: At the first detection of motion, the LED s will activate and flash rapidly on & off for up to 30 seconds
But if there is continued motion within the next 3-5 seconds, then sound will be activated. If motion is still being detected after 10-12 seconds, along with continued sound the LED s will flash more rapidly in an irregular pattern that differs from the original pattern, or if no further motion is detected, then the sound should be turned off while lights keep flashing for up to another 30 seconds. A testing matrix will evaluate different combinations of light and sound escalation and deescalation in the alpha prototype field test.

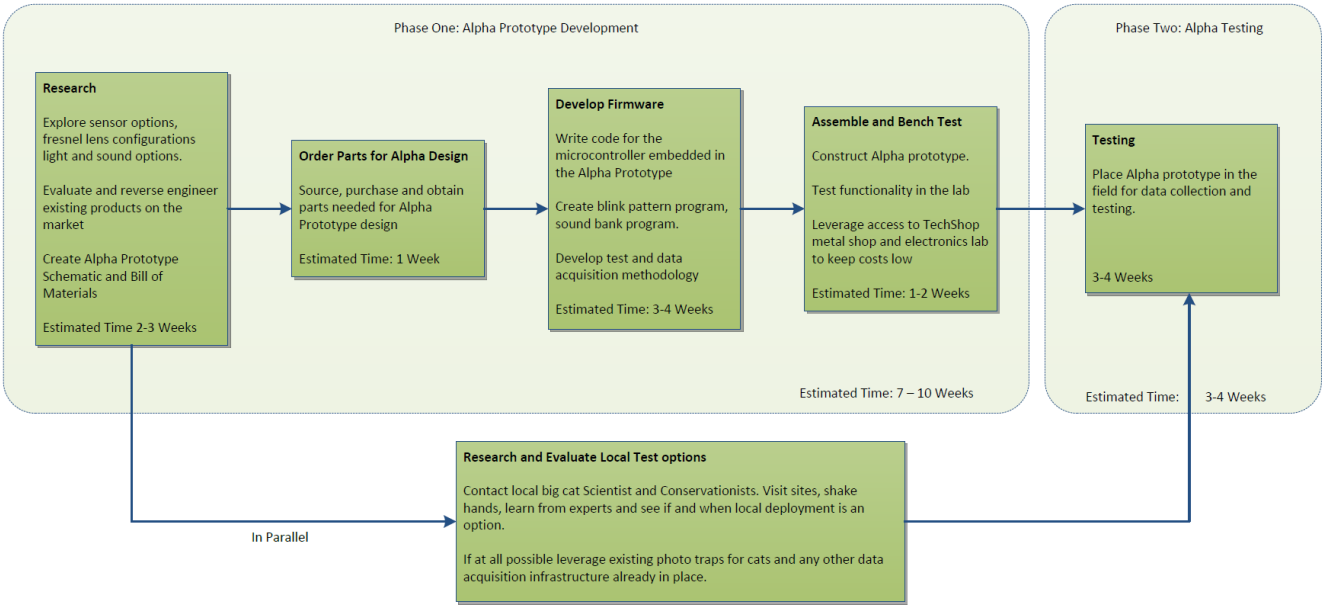
Key Attributes: Solar powered rechargeable battery, randomized non-habituating light and sound patterns, Automatic escalation and de-escalation of warning level, Built in motion detection, Ultra bright multicolored LED's, rugged and waterproof, automatic night-time detection, tamperproof.

Stages of Prototype Development:



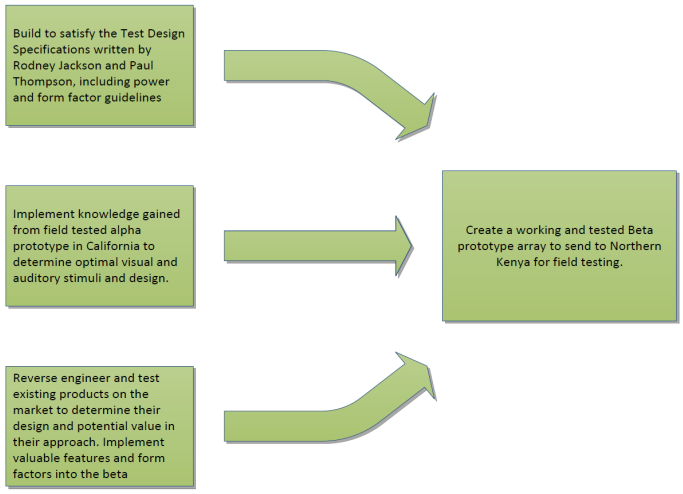
Phase One: Alpha Stage

The goal is to have beta prototypes to deploy to Kenya for testing as soon as possible. The first phase consists of construction and testing of an alpha prototype. The alpha prototype will have a larger form factor than the beta. It will not focus on cost or power management as it exists to test sensing and actuation in the field. The purpose of the alpha prototype is to test the motion sensor in the field and to carry out a testing matrix of consisting of various visual and auditory stimuli patterns. A breakdown of the estimated alpha prototype schedule is shown below:

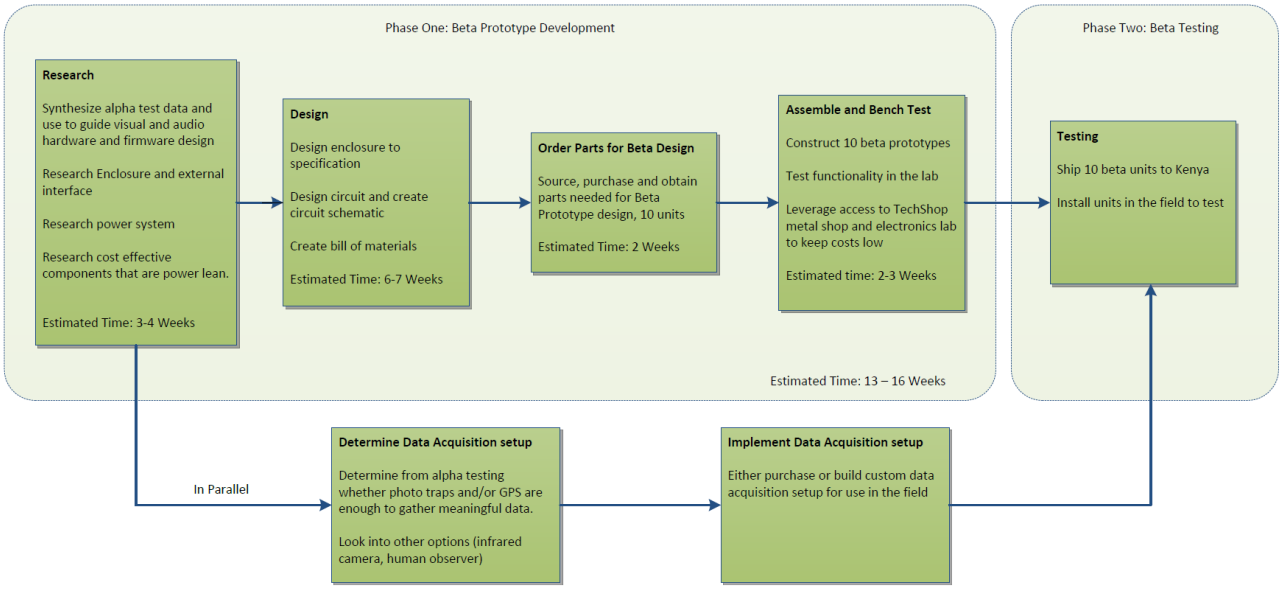


Phase Two: Beta Stage

The beta prototype will use the knowledge gained from the alpha prototype field tests and combine it with the knowledge gained from studying existing products *(Predator Guard*, *Niteguard*, *Foxlight).* This will culminate in a set of prototype devices to be shipped to Kenya for installation and testing. In addition a data acquisition system will be implemented in the field to determine effectiveness of the beta units. Some data acquisition examples may be: a photo trap, infrared camera or human observer. Below is a chart showing what principles will guide the design of the beta prototype.



The Beta prototype and estimated time line is outlined below.



Key Milestones:

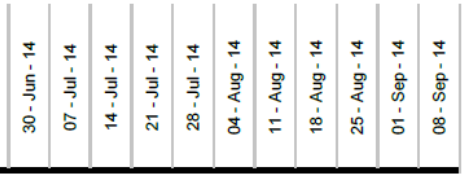
Development is scheduled to begin on Monday June, 30th . A time line is provided below, showing the breakdown of tasks and an estimated schedule through September 9th. Laboratory research and development will happen in parallel with research and evaluation of local test sites. Alpha prototype research and development is estimated to be completed and ready for deployment for local testing in the field by September 9th. Finally key milestones are displayed.

Anti Predator Device Project Timeline

Through September 9th, 2014

Project Leads: Chris Vargas, Michael Santullo,
Today's Date: 6/28/2014 (Sat) (vertical red line)
Start Date: 6/30/2014 (Mon)
First Day of Week (Sun=1): 2

WBS	Tasks	Task Lead	Start	End	Duration (Days)	% Complete	Working Days	Days Complete	Days Remaining
1	**Alpha Research and Development**	Brian	6/30/14	7/21/14	21	0%	16	0	21
1.1	Explore and research components, light, sound, sensor, enclosure		6/30/14	7/07/14	7	0%	6	0	7
1.2	Evaluate existing products, create Specification document		6/30/14	7/07/14	7	0%	6	0	7
1.3	Create alpha prototype Schematic and bill of Materials		7/07/14	7/17/14	10	0%	9	0	10
2	**Order parts for Alpha Design**	Brian	7/17/14	7/24/14	7	0%	6	0	7
2.1	Source, purchase and obtain parts for Alpha Design		7/17/14	7/24/14	7	0%	6	0	7
3	**Develop Firmware**	Brian	7/24/14	8/21/14	28	0%	21	0	28
3.1	Design and write Firmware architecture, state machine running on uC		7/24/14	8/03/14	10	0%	7	0	10
3.2	Create blink pattern and sound bank patterns matrix		8/03/14	8/08/14	5	0%	5	0	5
3.3	Develop test and data acquisition methodology		8/08/14	8/21/14	13	0%	10	0	13
4	**Assemble and Bench Test**	Brian	8/21/14	9/04/14	14	0%	11	0	14
4.1	Construct Alpha Prototype		8/21/14	8/28/14	7	0%	6	0	7
4.2	Test Functionallity in the lab		8/28/14	9/04/14	7	0%	6	0	7
5	**Research and Evaluate Local Test Options**	Brian	6/30/14	9/08/14	70	0%	51	0	70
5.1	Schedule and attend meetings with local cat researchers and specialists		6/30/14	7/21/14	21	0%	16	0	21
5.2	Learn from the field experts. Study field data acquisition possibilities.		7/21/14	9/08/14	49	0%	36	0	49



Key Milestone Dates:

Alpha prototype circuit design and firmware code completed by: **8/21/2014**

Alpha prototype built and tested ready for local deployment by: **9/8/2014**