Proposal to Implement a Surveillance System at the Cal Poly Dairy

A Senior Project

presented to

the Faculty of the Dairy Science Department

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of the Requirements for the Degree

Madelyn Cobb; e.g. Bachelor of Science

by

Madelyn Cobb

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ABSTRACT

The objective of this project is to determine how to implement a cost effective and efficient surveillance system at the Cal Poly Dairy. This system would help monitor labor, feed, and cows while increasing the biosecurity, accountability, and efficiency throughout the Cal Poly Dairy. To make this determination, I researched different types of products and the equipment necessary that will meet the needs of the dairy currently and for future projects. A list of specifications was created that help guide the search for appropriate companies and products for this project. Talking to surveillance experts also helped create a better sense of what is necessary to implement a system like the one desired at the Cal Poly Dairy. I found that there are many companies who are appropriate for this project, though only a couple have products that meet all of the specifications. Identifying the right manufacturers, systems, and integrators is important in getting this system implemented. Follow up work will be necessary to make sure that the systems proposed meet both the long and short term goals of the Cal Poly Dairy.

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INTRODUCTION

This project is important because it establishes a necessary outline to put cameras and a general surveillance system up at the Cal Poly Dairy. Implementing this system will enable endless possibility in surveillance and monitoring of labor, feed and employees at any point of the day or night at the Cal Poly Dairy. It will also create the opportunity for numerous research projects in the future, benefiting the students and the dairy alike. There is an endless list of uses and applications for the proposal system.

The need to put a surveillance system up at the Cal Poly Dairy is high. A surveillance system will bring the Cal Poly Dairy into the 21st century of security, and help create a higher educational use of the dairy herd and facilities now and for the future. Presently it will help with general inventory control, food security, biosecurity, and help prevent bioterrorism. Also, it will provide a better understanding of where the herd has general problems or is succeeding. For example, health, cow comfort, and lameness issues can be monitored and responded to.

Numerous articles have been written about the use of cameras on a dairy for monitoring and research. In the Journal of Dairy Science multiple articles have been written on monitoring feed intake, behavior and water consumption. Being able to observe the feeding behavior of individual cows through a computer system (Bach. et al, 2004), will enable more accurate nutrition management and, potentially, additional flexibility for applied research. DeVries. et al. (2003) used a similar system to monitor feed intake rates throughout the day. Studies have also been done on the monitoring of locomotion and posture of all ages of cows and heifers. All of these studies and more

will be able to be done with the implementation of cameras at the Cal Poly Dairy, many of which can also help create a higher quality of production out of the dual breed herd. Also, camera observation will help identify aspects of the dairy that may need improvement. The research possibilities enabled by the implementation of this surveillance system will be endless. There are no specific articles about surveillance systems and their uses on a dairy. However that does not mean that the Cal Poly Dairy cannot be the first.

The cameras will also be able to increase milk room security -- who deals with the milk, and its transfer of hands before it gets picked up each week. This system will also be able to monitor labor, cow and feed movement, specifically how each part of the dairy - cow, employees and feed - interact with the others at any given point throughout the day. What is unique about the Dairy at Cal Poly is that it is very public. Visitors of all sorts are welcome: families, Cal Poly students, students from other schools, and whoever else would like to pet the cows are able to walk onto this dairy and view and pet the cows. Because of this extreme public access, implementing a surveillance system will help monitor who is entering and exiting the dairy, providing a form of biosecurity and control that Cal Poly and herd managers have not been able to have in the past. The importance of biosecurity and preventing bioterrorism on a dairy, and dealing with cattle in general is high. Without it the transfer of disease is likely to happen. USDA's document on biosecurity through the Bovine Alliance on Management and Nutrition dairies states that "Bio security is one management strategy that producers can view as insurance from disease. Implementing biosecurity practices on a dairy can increase profitability by reducing clinical disease and improving production efficiency.

Controlling disease will reduce risk with minimal costs." This USDA article goes on to talk about protecting a herd for disease and ways to prevent it. At Cal Poly, since the dairy is open to the public twenty-four hours a day the first step should be to monitor who enters and exits. Preventing different diseases from entering the property in general will help with efficiency of the herd, profitability, and general health. The Cal Poly herd depends on its health. Without it the dairy is useless. Since it is an educational dairy, some trial and error goes into what works and what does not, however the National Center for Foreign Animal and Zoonotic Disease Defense (FAZD) is one group that is proactively working on preventing the introduction of diseases into a herd. They advise a number of things to do to prevent disease. One main point is to limit visitor access. Since this approach is not logical at the Cal Poly dairy, the next best option is to be able to monitor the visitors and make sure that there is a way to go back and see who has entered and exited the Cal Poly Dairy. This capability also enhances food security. To be able to monitor the Cal Poly Creamery staff who pick up milk multiple times a week, and the trucks that come in from the Central Valley, which will increase accuracy of monitoring milk disappearance. This is especially important since the student work force who manage and are a part of the main aspects of the dairy operation are always changing. Students come and go for every quarter. This regular labor change makes it difficult to have a consistent work force and style and know who is handling the milk on a regular basis.

This surveillance system will eliminate and help deal with any problems that occur, which in the past have been difficult to solve. It provides proper knowledge of any issues or any events that happen in and around the cows or employees, both positive and

negative. Having this kind of system will keep those who work accountable for their actions and responsibilities. And, in the long run, the system will help to prevent problems and create more opportunities for research and herd knowledge.

Objective

This project will give the Dairy Science Department at Cal Poly the necessary information to request bids on a cost effective and efficient surveillance system at the Cal Poly Dairy that meets the specifications below.

The set of specifications for this project are:

- Web enabled- IP Camera, Wireless Cameras
- Administration Access, log-in necessary
- 24/7 Video Recording
- Night and Day Vision
- Motion Detection
- Weather/ Animal Resistance: general durability
- Indoor/ Outdoor Capability
- Individual Moments/ Focus
- PTZ (pan, tilt, zoom), remote control for cameras
- 30+ fps (frames per seconds)
- HD quality Video
- Enough hard drive space/ storage space for (at least) seven days of rolling video

- Enough band width for 24/7 streaming video
- Monitor large enough to view multiple cameras at the same time

LITERATURE REVIEW

A surveillance system like this has never been implemented before at the Cal Poly Dairy. However it is now necessary to move our dairy into the future and install a state of the art system that will benefit the dairy and the hands on, learn by doing method that Cal Poly prides itself.

There are many Internet sites that focus on surveillance systems and cameras. When searching online for 'digital surveillance system', 'surveillance system', and 'monitoring system', sites of all kinds come up with all kinds of package deals or individual set ups. There is everything from cheap (under $100) Internet Protocol [IP], Pan Tilt Zoom [PTZ], weather resistant cameras to cameras that range in price from $500- $4000. Each has different capabilities and features that determine the price and make it necessary to review for a possible camera for the Cal Poly Dairy. There were also set up kits that have four to thirty- two camera, cords, monitors and everything you need from $1000- $10,000. However, it is important to look at the specifications that are necessary to have the best camera for its specific purpose. The reason for this is there are hundreds of cameras out there, some better then others, some great, and some which do not meet all of the specifications of the Cal Poly Dairy. If they do not meet Cal Poly's criteria, then they are not worth looking at. It is also important to look at how the

manufacturers interact with each other. Even though most systems are interchangeable, there are a few that are not. Because of the list of specifications for this project, it is important that everything works together flawlessly. For example Onvif, a non-profit organizations who's goals are "committed to the adoption of IP in the security market… ensure[ing] interoperability between products regardless of manufacturer." According to www.onvif.org, the company is an open Internet forum intended to help develop a global standard for IP-based security products. Like the ones that are planning on being used at the Cal Poly Dairy. Some of the manufacturers like Pelco, Axis Communications (one of the founding companies), and Bosch are all being considered as appropriate manufacturers for a surveillance system. These are just three examples of many companies that are appropriate manufacturers of surveillance cameras that meet most of the specifications.

Each company mentioned above: Pelco, Axis Communications and Bosch manufactures products which provide the necessary equipment and installation appropriate for this project.

Some of the general concepts that have to be understood are the types of cameras and systems which could be used for this project. There are different types of recording systems out there. Digital Video Recorders [DVR] are very common, for example. They are the ones that are used to record your favorite television show. It may seem appropriate for this project, however there are better systems out there. Instead of using a DVR, a Network Video Recorder [NVR] is better, since it works with an outside storage device that would record a full weeks worth of information from every camera on one storage hard drive. NVR's also work with IP Camera. The reason for the use of an IP

camera is that these are a type of digital video camera more specifically used for surveillance and mainly used for sending and receiving data (in Cal Poly's case, video) via a computer network and the Internet, both of which are readily available at Cal Poly.

The next aspect to understand is frames per second [fps] coordinating with bandwidth, megabits per second [mbps] or Megabytes per second [MBps] and storage space. Each of these components are necessary to understand why certain products were selected. The frequency at which an imaging device produces frames is termed fps. Thirty to 60 fps and higher is normal for a standards video, or television. Then there are two types of formats i and p. The i stands for interlaced – a regular television, while p stands are progressive, which are more commonly used for high end HDTV type systems. For the cameras that will be used for the surveillance system desired at the Cal Poly dairy the fps will be at 25/30, if not already an HD camera. The higher the fps, the more storage space it takes up. To make a motion look and appear smooth, without any choppiness, a higher fps is also necessary. However video recording does not have to happen if nothing is going on. Next the amount of bandwidth necessary depends on the fps, which then affect the mbps. Each is related to the others. Megabits per Second refer to data transfer speech over the Internet. Each video, email, social media site uses some kind of Mbps. That use is related directly to bandwidth, which is the measurement of available or consumed data, normally expressed in megabits. Most video recording is stored as H.264 or MPEG-4 Part 10 or AVC (Advanced Video Coding) is a standard for video compression. It is currently one of the most commonly used formats for the recording, compression, and distribution of high definition video. Figure 1 is an abstract example of the use of mbps and bandwidth and how it relates back to fps.

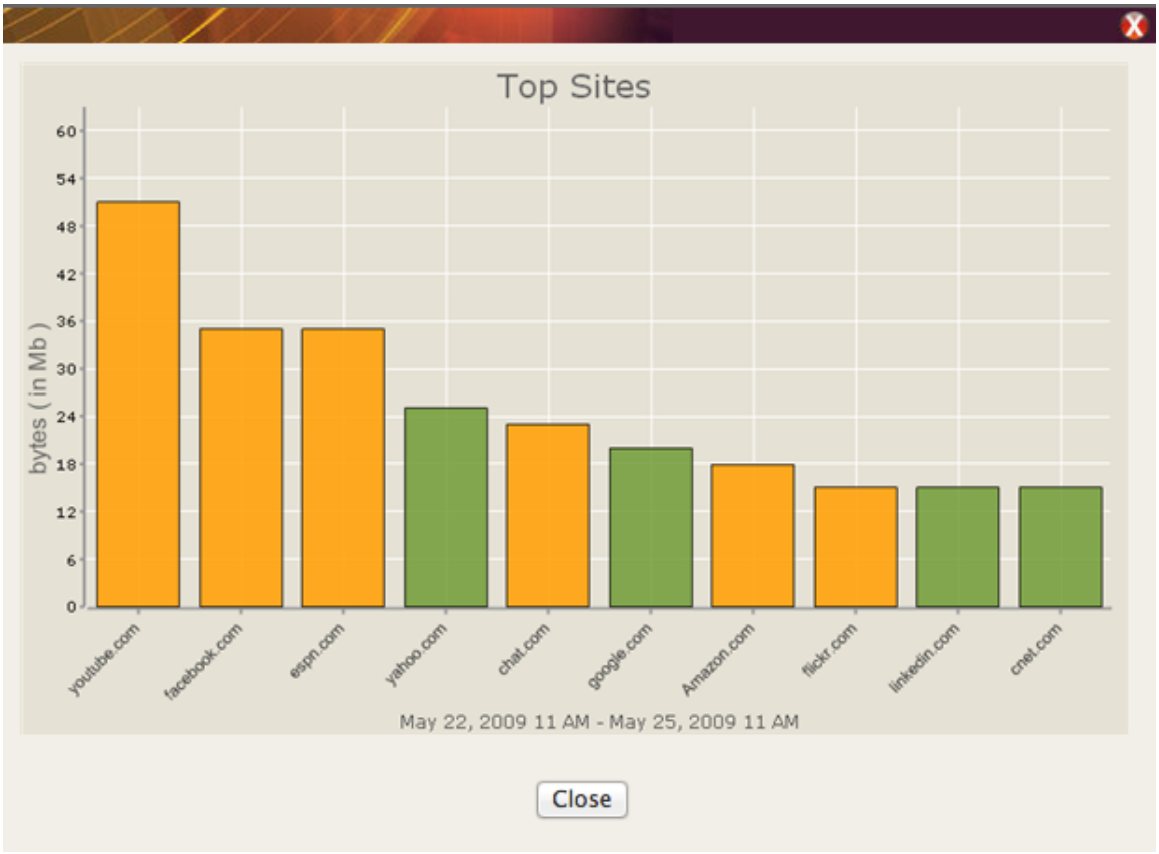

Figure 1. Comparison of Data Transmission Rates Among Common Internet Sites

To accommodate all of the expected video an external hard drive is going to store all the video footage. This hard drive and general computer storage is measured in megabytes [MB], gigabytes [GB], or terabytes [TB]. The largest size of storage is TB. This size of storage will allow us to look back at least through one week's worth of video recording, if not more. Which will enable us to view what happened the past week.

Bit	The smallest unit of data that a computer uses	
Byte (B)	= 8 bits	
Kilobyte (KB)	= 1 000 bytes	
Megabyte (MB)	= 1 000 000 bytes	
Gigabyte (GB)	= 1 000 000 000 bytes	
Terabyte (TB)	= 1 000 000 000 000 bytes	= 1 000 gigabytes
Petabyte (PB)	= 1 000 000 000 000 000 bytes	= 1 million gigabytes
Exabyte (EB)	= 1 000 000 000 000 000 000 bytes	= 1 billion gigabytes
Zettabyte (ZB)	= 1 000 000 000 000 000 000 000 bytes	= 1 trillion gigabytes
Yottabyte (YB)	= 1 000 000 000 000 000 000 000 000 bytes	= 1 quadrillion gigabytes

Figure 2. Data Storage Capabilities

All of these concepts and ideas about different aspects of surveillance systems are going to be used and referred back to in the Methods and Materials and the Results section.

The Cal Poly Dairy will benefit from a surveillance system because the dairy is not just an educational site. It is also a production dairy that needs to be treated like any other. This means that the dairy operators need to be conscious about biosecurity and bioterrorism, and make sure everyone who enters the dairy is accountable for their actions. As an educational center the Cal Poly Dairy also prides itself on teaching students correctly.

MATERIALS AND METHODS

Data Collection

The data collected for this project was all done through the Internet. I looked at different manufacturers websites and integrator sites to find what are the most appropriate for this surveillance system. I then contacted individual companies to better understand their product. I also talked to business owner such as Curtis Streeter from Deep Blue Integrations, and Joe Thistle from Axis Communications to better comprehend how all of this could come together.

One of the biggest obstacles in this project is going to be the location of the cameras and the NVR. Figuring those locations gives me a better understanding of what kind of camera will work best within the limits of the Cal Poly Dairy.

Location of Cameras

The locations of the camera are critical. To utilize the cameras effectively the location of them are specific, to allow the viewer to see what is going on throughout the entirety of the dairy. The location dictates the type of camera that is necessary for that specific location. It is important to make sure that everything is appropriate for the location and use.

The locations of the cameras are going to be placed around the dairy and building 18 for the best visual of what is going on at any give time of the day or night. The system enables the viewer to see the cows, feed, and the employees. The pictures with the

descriptions below are included to give a better understanding to why these locations were chosen.

Those who are actively involved in this project were in charge of choosing the final locations for the cameras: Dr. Leanne Berning, Rich Silacci (Cal Poly Herd Manager), and Madelyn Cobb.

Types of Cameras

There are two camera designs that are being considered at for this project: PTZ (pan- tilt- zoom), and Fixed. Each type has different capability in viewing the area desired, the size of the video images, cost, zoom, and placement. The types of cameras that will be beneficial in each location will be presented in the Results section, and truly depends on the final cost of this system.

1. ***Milking Parlor.*** This will allow the viewer to monitor the milkers, and the cows at any given point of the milking process and the milkers behaviors in the parlor, to each other and or to the cows. The viewer will be able to see the cows behavior while being milked. In general the cameras will let us monitor animal behavior, interactions with individual milkers, productivity and efficiency.

1b. ***Tank room.*** This camera will allow the viewer to monitor how the milker sets up and takes down, when milk is picked up during the week, if the wash for the tanks was turned on or not, and if the pipes where put back correctly or not. Also, it will record when milk gets picked up by both the creamery staff and the other trucking companies who pick up the milk.

2. ***Main walking lane up to the milking parlor/ Holding pen.*** This camera will allow the viewer to watch cow movement as they approach the milk parlor, when they walk away, and while they wait to be milked. Also monitoring the cows in the holding pen.

3. ***Employee Entrance/ Northwest Entrance.*** The viewer will be able to see who enters and exits the milking parlor, and who drives into the barn area and the surrounding premises. This camera is important for biosecurity reasons.

4. Maternity/ Hospital Pen. These cameras will allow the herd manager and the viewer to see what is going on in that pen whenever they like. This can prevent cows from giving birth without anyone's knowledge. Also be able to monitor cows that are sick and watch their actions. The cameras will be placed in such a way to see the cow movements in this pen, the head locks and when the cows are eating.

5. ***Calf Box Stalls.*** This camera will be able to monitor the young calves, health, general maintenance, and feeding. Also be able to view the other side of the maternity pen to view expecting or sick cows that are placed in that side of the maternity pen.

6. The Commodity Barn. This will allow the viewer to monitor feed use and the feeder. Hay usage, general maintenance in this area, and general security to make sure hay does not get stolen

7. ***Milking Herd Barn***. Putting multiple cameras between these two barns of Holsteins and Jerseys which will allow the monitoring of cow moment, rumination, standing, sitting, eating, drinking water, etc. This will also allow employees monitoring while they handle the cows. Make sure that they are pushing up cows correctly, gates get open/ closed, stalls get raked correctly, the feeders are giving the correct feed to each pen,

and how the herdsmen's deal with the cows in general. The locations of these cameras are not yet decided since it depends on the final price, however the entire area of the two barns need to be completely viewed.

8. ***Far Barn/ Young Stock Barn.*** This camera will allow the viewer to monitor the young stock. Watch their growth and development and general maintenance. The cameras in this barn can also be used for research projects in the future.

9. ***Covered Calf Area/pavilion.*** This will allow the viewer to monitor the calves feed, and general health, the calf feeder and how they are doing their job, and the general area to make sure no outsides sources are affecting the calves and their health. Also this will allow general surveillance for the storage in the area.

Figure 3. Aerial View of the Cal Poly Dairy

Figure 4. Aerial View of the Show Barn/ Pavilion

Figure 5. Aerial View of the Commodity Barn

Figure 6. Aerial View of the Milking Barn, Parlor, Tank Room, Holding Area, Employee Entrance

Figure 7. Aerial View of the Cow Barns

The estimated number of cameras to be placed throughout the dairy is sixteen (16~20).

The NVR system

Will be located in Dr. Bernings lab at the Cal Poly Dairy in room 117 A. This will be the location for the main storage system of all the video from the cameras throughout the dairy. From here the IP address will be able to be seen from any computer through the Cal Poly IT network depending on if the viewer has the administrator password or not. The size of the NVR system is still being discussed and depends on how many cameras there will be and the amount of video being sent on a regular basis.

Monitoring System

The main location to view the camera would be in Dr. Leanne Berning's Office on the Cal Poly campus in building 10. Allowing her to monitor who is watching the dairy and reviewing the videos. The IP address to view the dairies cameras will need a specific log in and password to access the live video stream. This system will most likely include a new monitor, external storage, and any necessary control needed for controlling the video cameras.

Specifications of Cameras and System

- Web enabled- IP Camera, Wireless Cameras
- Administration Access, log-in necessary
- 24/7 Video Recording
- Night and Day Vision

- Motion Detection
- Weather/ Animal Resistance: general durability
- Indoor/ Outdoor Capability
- Individual Moments/ Focus
- PTZ (pan, tilt, zoom), remote control for cameras
- 30+ fps (frames per seconds)
- HD quality Video
- Enough hard drive space/ storage space for (at least) seven days of rolling video
- Enough band with for 24/7 streaming video
- Monitor large enough to view multiple cameras at the same time

Online/Personal Research

When looking for cameras and the best surveillance systems I originally talked to Curtis Streeter of Deep Blue Integrations. His company provides surveillance installation, fire and life safety, access control, CCTV/ camera installation, and other integration services. Curtis suggested looking at a couple of sites which his company recommends and uses. This initial phone call allowed me to start the search for the best system. From here I also talked to Joe Thistle from Axis Communications, and Randy Kuntz from Valley Agriculture Software.

Each contact allowed for a better understanding of the types of cameras and systems that are available. Most of the research was done over the Internet. I also looked at surveillance websites, which also had IP cameras that are appropriate for the conditions

at a dairy, monitoring systems and a DVR or a NVR device. With the criteria Dr. Berning provided, I was able to find cameras and a system that will give us a better idea of what we want to install at the Cal Poly Dairy. Also I made sure that what is being looked at makes the specifications set forth. From this point I was able to narrow down my search from the initial twenty plus surveillance sites, to the top few which have the type of camera and monitoring system desired for the Cal Poly Dairy.

Integration

Since there are many different kinds of cameras, NVR's systems and software on the market, it is important that what we choose work together. This being said it is important to choose an integration company that is capable of putting everything together correctly and efficiently. To do this the company should be are part of OnVif, and use products that are part of this company. Deep Blue Integrations is one of these companies, and is also approved by the Cal Poly Corporation. Besides Deep Blue, there are other ones in the area who work with farms, and dairy specifically. Moonblink, and Valley Agriculture Software are other integration companies who are able to put together this kind of project that are located in the area.

Other Considerations

Surveillance systems are more then just putting cameras up. Other components that need to be considered are mounts for the cameras, power, electricity, wires and cords at each location, and then placement for the main power box. An integration company is able to give the appropriate recommendations for the right product in each of these

situations. For examples, the choice of wall mounts will truly depend on the final locations of the cameras. If the camera is placed in the tank room versus out in the milk cow barn, the type of mount will vary. These locations will dictate what kind of mount that is needed, the length of the cords and any other equipment that will make this system possible. It will also change the price since the length of cords will vary. For certain cords it will depends on the types of cameras that are chosen, the size video, what will be better in the long run and will allow the Dairy Department to do more. This will be more specific once bids from companies are finalized.

Both Pelco and Axis Communications have wall mounts for their cameras that are suitable for the different settings out at the Cal Poly Dairy. The paper work is in the appendices for these products.

Data Processing

These are the manufacturers with some of the specific products that would be appropriate be used at the Cal Poly Dairy:

Top Manufacturers:

1. Pelco, by Schneider Electronic
2. Axis Communications (founding company in OnVif, world wide #1 in network video)

Table 1. Top Camera Manufacturers Cameras

Pelco	Axis Communications
IE30 Series Sarix® IP Rugged Fixed Dome; Indoor/Outdoor, 3.1 Megapixel High Definition Digital Camera	Axis Q6035/-E PTZ Dome Network Cameras, HDTV 1080p PTZ dome with 20x zoom for ultimate video quality
IE 10 Series Sarix® IP Rugged Fixed Dome; Indoor/Outdoor, 1.3 Megapixel High Definition Camera	Axis P5534- E PTZ Dome Network Cameras, Outdoor- Ready HDTV cameras with 18x zoom
Sarix ® IM10-E Series Environmental IP Mini Fixed Dome; Indoor/Outdoor, 1.3 Megapixel, High Definition Digital Camera	
	* These are the to two camera in there series. There are more cameras within these product types, the differences are the price, HDTV ability, zoom and minuet details which do not affect the overall performance and still meet the specifications.

The specific product literature work these cameras are in the Appendices 4.

RESULTS AND DISCUSSION

Through the research I have found that certain manufacturers are better then others and that specific types of cameras will be better throughout the dairy then others. Also, that all of the specifications desires can be done through an integrations company that works within all of these parameters and the software chosen.

I found that the top manufacturers of cameras and surveillance systems are Pelco, and Axis Communications. These two have proven to have the best equipment all around. The other two companies: Avigilon and NetVision Mobile have also been helpful with sharing product information with me.

Table 2. The Contacts for the Manufacturing Companies

Axis Communications Joe Thistle Account Executive Western Region, Axis Communications, Inc. 800 444 2947 Option 3 Joe.Thistle@axis.com	Avigilon Gary Thomas- avigilon Regional Sales Director N. California, Hawaii & N. Nevada Cell: 925.864.3799 | Fax: 925.470.2415 Support: 888.281.5182 | avigilon.com Reta Orahim Inside Sales Coordinator Avigilon tel: 604.629.5182 fax: 604.629.5183 support: 888.281.5182 www.avigilon.com
Pelco Ken Massrey Ken Massrey Associates, Inc. 949-341-0740 714-606-6058 Mobile	Netvision Mobile, Geo Vision Lauren Grogan Inside Sales & Event Marketing Specialist Digital Management Solutions 1200 Woodruff Rd. Suite B15

ken@kmacctv.com Corporate Headquarters and Demo Room Email: sales@kmacctv.com 550 Wald Irvine, CA 92618 (949) 341-0740 Phone (949) 341-0744 Fax	Greenville, SC 29607 Office: 864-213-6300 Toll Free: 1-800-380-9365 Fax: 864-751-2802 Email: lauren@dmsusa.net www.dmsusa.net www.netvisionmobile.com www.dmssolarvision.com

Both top companies are apart of Onvif, have IP cameras that meet our specifications, NVR's, surveillance software, and can work together if necessary. Other companies that are apart of OnVif that were looked at for this project: Bosch, Cisco, Panasonic, Samsung, Sony, and Honeywell.

The types of cameras what will give the best picture and quality for the maximum amount of area covered are PTZ cameras. Fixed cameras will allow for substantial coverage, however are not going to allow for the same amount of long term research benefits. PTZ cameras will allow the Cal Poly dairy to have larger coverage, high quality of zoom, both during the day and at night.

In regards to integrations companies, Deep Blue Integrations has been in the most contact with us, and is the closest to Cal Poly. However Moon Blink, and Valley Agriculture Software are both recommended and useful companies.

Table 3. Integrators/ Integration Companies

Curtis Streeter, SET□Deep Blue Integration, Inc.□C-10,C-16 943465 ACO 6864□1-888-6000-DBI, 1-888-600-0324, Cell 805-550-4553 www.deepblueintegration.com	Deep Blue Integration Approved by the Cal Poly Corporation
Headquarters (West Coast) Moonblink Communication 1211 Alderwood Ave, Sunnyvale, CA 94089 Toll Free: 1-877-623-5223 International: 1-408-850-1143 Fax #: 1-408-350-2020	MoonBlink Shawn Birkett 408 329 6532 Cody Martin Partner Development Manager (Southwest) | Moonblink Communications, Inc. 877-623-5223 x5606 408-701-5606 (Direct) | cody@moonblink.com |www.moonblink.com |
Address:□Valley Agricultural Software□3950 South K Street□Tulare, CA 93274 USA Phone:□Toll-Free: 888-225-6753□International: 559-686-9496□Fax: 559-686-6253	Valley Ag Software Manuel Prez 888 225 6753 Randy Kuntz randy@vas.com Makes dye to put on cows to locate them at night that the axis communications cameras pick up. Also uses DC 305.
Corporate Headquarters□140 Knowles Drive□Los Gatos, CA 95032□United States□Driving directions Tel: +1 (408) 399-7771□Fax: +1 (408) 317-1777□email: info@firetide.com	Firetide (not an integration company, but suggested by Joe Thistle from Axis Communications)
Headquarters 1561 Buckeye Drive□, Milpitas, CA 95035□USA□Map & Directions Toll Free (USA): 1 800-229-1630□Tel: +1 408-383-7600□Fax: +1 408-383-7680□Technical Support: +1 866-674-6626	Proxim

The Types of Cameras and Best Locations

The numbers correspond to the figures and descriptions from the Materials and Methods sections.

All of the cameras should be able to handle the environment, the Cal Poly dairy is 95% outdoors, and the four or five cameras that are going to be covered are going to be exposed to high moister/ water. The Cal Poly Dairy is open to both PTZ and fixed, however we want to make sure that the max amount of area gets covered. Either way the cameras will need to be vandal and environment resistant, and able to deal with high water content.

1. Milking Barn, Tank room

a. Milking barn. Two PTZ cameras that are vandal resistant and can withstand the environment are required in the milking barn. Each should be mounted high enough to provide a good angle view down at the milkers and the cows being milked. However fixed cameras are plausible if angled correctly.

b. Tank room. Two PTZ cameras that are vandal resistant and can withstand environmental elements, especially since there is a lot of water/moister use in this room. The cameras will be placed at either side of the tank room to be able to get the maximum coverage of the holding tanks, and pipes. These particular cameras will have the closest proximity to students.

2. Main walk lane, holding pen

a. One camera PTZ camera that can withstand the environment that will be placed directly above the holding pen.

3. Employee Entrance/ Exit

a. One PTZ camera that is vandal resistance and has durable environmental qualities. This camera will be placed under the northwest outside staircase.

4. Maternity/ Hospital Pen

a. One PTZ or fixed camera that are vandal resistant and can withstand the environment. This camera will be placed high enough to get a view of the cows that are either sick or waiting to calve.

5. Calf Box Stalls

a. One PTZ camera that can withstand the environment. That will be placed high enough to be able to watch the calves or maternity cow that are expecting to calve.

6. Commodity Barn

a. Two PTZ cameras that are vandal resistance and can withstand the environment. These cameras will be placed on the either end of the commodity barn at the roof corners with the view of the feed and the surrounding area.

7. Milking cow barn

a. Multiple PTZ and or fixed cameras that are both environmental and vandal resistance. Placed throughout the barn at different angles and heights to get the best coverage of the feed, headlocks, free stalls and lanes. The estimated size of this barn is: length 350~400 ft, width ~ 200 ft.

8. Young Stock/ Far Barn

a. Multiple PTZ or fixed cameras that can withstand the environment. The cameras will be located at different heights and angles to be able to get the best coverage of the young stock and various other cows.

9. Show Barn/ Pavilion

a. One PTZ camera that is vandal resistant and can withstand the environment. This camera will view the calves and the storage items in this area .

Flex Area

These specifications of amount, location and primary surveillance areas are subject to change depending on both the overall and product specific costs.

Table 4. Chart of Camera Locations and Required Specifications

Site Number/ Description	# of Cameras	Zoom	Night Vision	Vandal Proof	Environmental Resistance	Motion Detection	Timer Capability
1. Milking Barn **a. Tank room** **b. Parlor**	a. 2 b. 2	a. PTZ b. PTZ/ Fixed	a. yes b. yes	a. yes **b. yes**	a. yes b. yes	a. yes b. yes	a. yes b. yes
2. Walk up lane/ holding pen	1	PTZ	yes	no	yes	no	yes
3. Employee Entrance	1	PTZ	yes	yes	yes	yes	no
4. Maternity/ Hospital Pen	1	yes	yes	yes	yes	yes	no
5. Calf Box Stalls	1	PTZ	yes	yes	yes	yes	no
6. Commodity Barn	2	PTZ	yes	yes	yes	yes	no
7. Milking Cow barn	3-6	PTZ/ Fixed	yes	yes	yes	no	no

8. Far Barn/ Young Stock	2-4	PTZ/ Fixed	yes	yes	yes	no	yes
9. Pavilion/ Winter Calf area	1	PTZ	yes	yes	yes	no	yes
Total:	16~ 20						

Type of NVR system

A NVR system is preferred compared to a DVR. It allows for future surveillance technology to be integrated into this system. Both Pelco and Axis Communications have NVR's ranging in size. Either way this hard drive storage space will need to be in TB's. This storage capacity will allow for the most amount of data to be recorded and saved. The number of cameras and the type of video will help guide the choice of how much storage space will be needed and ultimately the price of the system.

Type of Software

The software will allow the viewer to rotate the cameras, zoom, take pictures, set up motion detection, put the cameras on a tour mode, have them on timers and numerous other features. There are different systems on the market, however both Pelco and Axis Communications have managerial software that work with their IP cameras and NVR's systems. However this software can be from any company that is able to work with the products and manufacturers that are going to be used at the Cal Poly Dairy.

Interpreting Results

Incorporating a surveillance system in to the Cal Poly dairy will allow for endless types of projects and accommodate future research developments, not to mention increased biosecurity, bioterrorism prevention, and monitoring of cow, feed, and labor

throughout the dairy. If possible this system should be implemented. Select the best cameras for the price because it will allow Cal Poly to do what ever is desired from the use of these cameras. Also choose the largest storage possible to allow for projects in the future to look back at video recording from longer then seven days. The system the Cal Poly Dairy desires is available. All of the specifications can be met, but the price will be the biggest obstacle.

The projects that have been performed in the past that use cameras have never been done with such depth or detail. This is the first of its kind, allowing for endless possibilities of results.

What I have found are the recommended cameras and companies to go with in the area for both specific products, and the companies that can set everything up.

Comparing Results

The locations and cost of cameras will depend on what type of cameras that will be chosen, then the NVR system and storage space. Other comparisons came with if the product met the specifications or not. It all came down to if the product met the specifications or not, and if so would it work at the Cal Poly Dairy.

Limitations to the study

The main limitations to this project are: cost, time, and manpower. Next it would be industry knowledge about surveillance systems and the overall process. The not being able to obtain Building 18 blue prints and floor plans. To find out where the electrical panels are, if outlets work or not, how much power is running through the building, how

far the wireless internet reaches from building 18 out into the facility, etc. Then what the CSU system needs for a project like this to get underway since there are restrictions to what can be done and who can work on state property.

CONCLUSIONS

We found that through the research that there are hundreds of surveillance companies out there. Most of these systems have cameras, recording systems and some kind of software. However not all of them are appropriate and meet the specifications of the desired surveillance system for the Cal Poly dairy. The specifications set at the beginning of this project dictated what we needed and created a detailed list to find the cameras that will work for this project, as well as NVR systems and management surveillance software that all work together to meet the needs to the Cal Poly dairy. Understanding the background of the cameras will give us a good idea what an integration company will talk about and say. This project should start by giving out specifications and allow for bids to come in. Then from there evaluate what each company has to say and what they can do to make this project work now and in the future. It is determined to be true that a system like this will help meet the needs of labor, cow, and feed management, then biosecurity and bioterrorism issues that could all arise.

What additional work that needs to be done is to actually get this system implemented and started. This is an easy project to expand on since there is a large flex area. Create a list of where more cameras can be installed and continue researching the benefits that this surveillance will have on the entirety of the Cal Poly Dairy. More additional work that may be needed is to incorporate more wireless Internet throughout the dairy barns to get the IP connection that the new system cameras will needs.

Some of the risk that will be incorporated in this project will be making sure the Cal Poly dairy gets what it wants. The placement and use of the cameras, software, how these are managed and who is going to continue maintenance of the surveillance system. Then being able to utilize the integration companies and the appropriate products. Most of the risks can be prevent if monitored carefully.

Lastly, since implementing a system like this will allow for future dairy research and prevention of bioterrorism towards the Cal Poly Dairy or dairies in general partial funding from government groups can help off set the costs of the total project cost.

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APPENDICES

Appendix 1: Consultations

Cutis Streeter Deep Blue Integration

November 2011

Phone conversation to get a basic idea of what is necessary and where to start looking for a project like this.

Joe Thistle. Axis Communications

January 31, 2012

Phone conversation about the different cameras they have, MSRP, and integration companies they have worked with in the past.

Curtis Streeter, Deep Blue Integration

February 10, 2011

Walk through the Cal Poly Dairy with Dr. Leanne Berning to talk about and visualize what this system would be like and what would be necessary.

Cody Martin, Moonblink Communications

February 2012

General inquiry about products and systems.

Randy Kuntz, Valley Agriculture Systems

February 2012

His suggestions for this project:
Hello Madelyn,
Points worth noting.
1) PTZ cameras are extremely impressive, however their one draw back is while it is pointing one direction it can not see behind itself at the same time. Thereby making it possible for it to miss something important occurring. They can be placed in a tour mode which has it rotating to presets predetermined. These PTZ's can always be interrupted by a user to look at a different view. When the user stops and the camera is idle the tour mode kicks back in.
2) When striving for clarity then digital end to end is the only way to achieve this because analog systems are not digital end to end. True IP systems are digital end to end. Any time you have an analog piece in the system you are not completely digital because while switching between analog and digital by default degradation occurs from the conversion of analog to digital and back. I am sure you are wanting to identify and not just detect through your future cameras.
3) The inherent technology behind IP makes it the most scalable option for surveillance systems.
4) Length of storage is determined by the amount of drive space allocated. If more is

wanted or needed, then more is obtained.

Appendix 2: Site Photos

Site Number/ Description:

Pictures of Camera Placement and then what the Camera should be able to see: this is subject to change depending cost and final location:

1. Milking Barn

a. Tank room

b. Parlor


2. Walk up lane/ holding pen



3. Employee Entrance



4. Maternity/ Hospital Pen



5. Calf Box Stalls


6. Commodity Barn

7. Milking Cow barn, 8. Far Barn/ Young Stock, and 9. Pavilion/ Winter Calf -- The Location for the cameras in these barns are up to discussion depending on the purpose and desired results.

Appendix 3: Copyright Permission

Permission for the use of Figure 2:

Rowena Loo (QSA) <Rowena.Loo@archives.qld.gov.au>

Cc: "Allison HICKEY (QSA)" <Allison.HICKEY@archives.qld.gov.au>

Hi Madelyn,

With regard to your request, as you are a student your intended use of the chart falls within the 'fair use' for research and study provisions of the Australian Copyright Act. Therefore you don't need permission to use the table and you are more than welcome to do so.

Our website is currently being redeveloped. As a result, URL will be changing probably from tomorrow. The table will still be there, but if you have any trouble finding it again just let me know.

Regards,
Rowena Loo
Principal Research Analyst, Digital Archives
Queensland State Archives | Department of Public Works

PO Box 1397 | Sunnybank Hills QLD 4109T: 07 3131 7761 (ext. 31761) | F: 07 3131 7764 E: rowena.loo@archives.qld.gov.au W: www.archives.qld.gov.au

Appendix 4: Product Literature