

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON**

**SYSTEM REQUIREMENTS SPECIFICATION
CSE 4316: SENIOR DESIGN I
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**TRAFFICNETPEONS
PRODUCT NAME: TBD**

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1 PRODUCT CONCEPT

This section describes the purpose, use and intended user audience for the camera. The camera will allow users to view its feed from a web browser, control its orientation such as zooming, panning, and tilting.

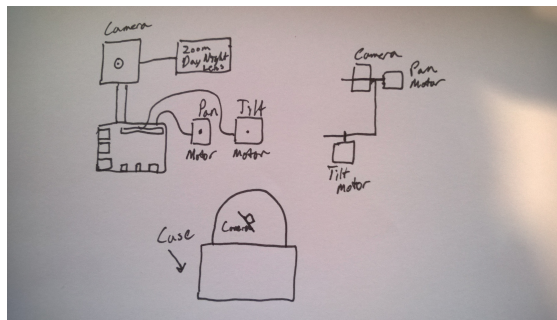
1.1 PURPOSE AND USE

The camera will stream image data at a minimum of 10 FPS, support 10x zoom, have day/night control, and be weather resistant. The entire system will rely on a total of 5W and be powered from a battery and solar panel. The user interface will be accessible from a web browser and have optional password protection.

1.2 INTENDED AUDIENCE

The camera is being designed and created for Traffic Net and is being targeted toward government agencies such as the Texas Department of Transportation. This product is meant to provide a durable and cheap replacement for existing products while being targeted for remote locations where extensive internet infrastructure has not been laid.

1.3 FIGURE 1.1



2 PRODUCT DESCRIPTION

This section provides the reader with an overview of the camera. The primary operational aspects of the camera, from the prospective of the end users, maintainers and administrators, are defined here. The key features and functions found in the product as well as critical user interactions and user interfaces are described in detail.

2.1 FEATURES & FUNCTIONS

The camera will be housed in a domed enclosure and two stepper motors, mounting bracket, Raspberry Pi Compute Module, and a Raspberry Pi Camera Module. As can be seen in Figure 1.1, The camera will be mounted on the top of a bracket with stepper motors attached at the joints to provide pan and tilt control. A Zoom and Day/Night lens will be attached to the Raspberry Pi Camera module and be connected to the Raspberry Pi for control.

2.2 EXTERNAL INPUTS & OUTPUTS

External Inputs:

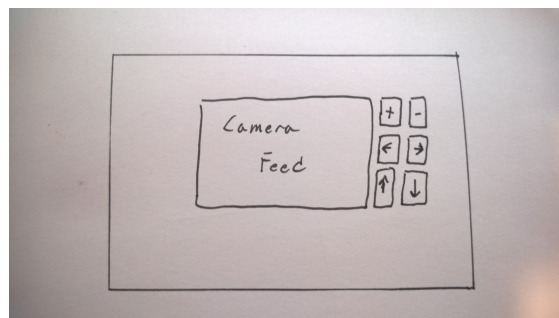
Zoom Control	The ability to control the current zoom level on the camera	The user will be provided with the ability to control the current zoom setting on the camera
Pan Control	The ability to control the current pan setting on the camera	The user will be provided with the ability to control the current pan setting on the camera
Tilt Control	The ability to control the current tilt setting on the camera	The user will be provided with the ability to control the current tilt setting on the camera
Image Feed Request	Fetches the current available frame for the user	When the user access the cameras portal, they will request a stream of the camera.

External Outputs:

Image Feed	Provides a stream of the camera	The camera will provide a stream of at least 10 FPS to the user
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2.3 PRODUCT INTERFACES

2.4 FIGURE 1.2



The Image feed can be seen in the center of Figure 1.2 and the various controls as specified in the External Inputs can be seen along the side of the camera feed. The various controls start at the top on

the right side and will be buttons that the user can interact with. Starting at the top is the zoom control followed by the pan and tilt controls.

3 CUSTOMER REQUIREMENTS

This section will define the customer requirements that are required for the camera to function and its various features. Each requirement specified in this section is associated with a specific customer need that will be satisfied. The requirements are the directly observable features and functions of the camera that will be encountered by its users. Requirements specified in this section are created with, and must not be changed without, specific agreement of the intended customer/user/sponsor.

3.1 MINIMUM OF 10 FPS

3.1.1 DESCRIPTION

The camera will provide a user with a minimum stream of 10 FPS/

3.1.2 SOURCE

Traffic Net

3.1.3 CONSTRAINTS

The camera needs to be able to maintain 10 FPS under load/

3.1.4 STANDARDS

None

3.1.5 PRIORITY

Critical

3.2 10X ZOOM

3.2.1 DESCRIPTION

The camera will have up to 10x zoom and be controllable from the user interface.

3.2.2 SOURCE

Traffic Net

3.2.3 CONSTRAINTS

None

3.2.4 STANDARDS

None

3.2.5 PRIORITY

Critical

3.3 DAY/NIGHT FUNCTIONALITY

3.3.1 DESCRIPTION

The camera will need to have the ability to function in both day and night.

3.3.2 SOURCE

Traffic Net

3.3.3 CONSTRAINTS

None

3.3.4 STANDARDS

None

3.3.5 PRIORITY

Critical

3.4 PAN AND TILT CONTROL

3.4.1 DESCRIPTION

The camera will have the ability for users to control the current pan and tilt settings of the camera.

3.4.2 SOURCE

Traffic Net

3.4.3 CONSTRAINTS

None

3.4.4 STANDARDS

None

3.4.5 PRIORITY

Critical

3.5 WEATHER RESISTANCE

3.5.1 DESCRIPTION

The camera will have the ability to resist certain weather conditions such as snow and rain.

3.5.2 SOURCE

Traffic Net

3.5.3 CONSTRAINTS

The camera will only be rated for a certain temperature range and if exceeded could damage the camera.

3.5.4 STANDARDS

None

3.5.5 PRIORITY

Critical

3.6 MAXIMUM OF 5W POWER CONSUMPTION

3.6.1 DESCRIPTION

The camera will be required to run on a maximum of 5W of power to ensure the solar panel can effectively power the camera.

3.6.2 SOURCE

Traffic Net

3.6.3 CONSTRAINTS

None

3.6.4 STANDARDS

None

3.6.5 PRIORITY

Critical

3.7 HEATER

3.7.1 DESCRIPTION

The camera will have a controllable heater to help melt snow or other obstructions off the camera dome.

3.7.2 SOURCE

Traffic Net

3.7.3 CONSTRAINTS

None

3.7.4 STANDARDS

None

3.7.5 PRIORITY

Low

4 PACKAGING REQUIREMENTS

This section will describe the packaging and what will be included with the product upon delivery. This requirement might change over time, but all items included will have a purpose and be necessary to the functionality of the surveillance camera. Packing requirements are those requirements that identify how the delivered product will be packaged for delivery to end-user; or how it will look when finished and delivered. The software might be customer installable. Hardware components will be in a single package. In our product we are delivering camera dome as only part. The additional parts to assemble will be delivered by Traffic Net according to the needs of the customers.

4.1 CAMERA DOME

4.1.1 DESCRIPTION

The complete product will be in the form of the camera dome as a main part.

4.1.2 SOURCE

Traffic Net

4.1.3 CONSTRAINTS

Functionalities are mainly focused for traffic surveillance and for outdoor use.

4.1.4 STANDARDS

None

4.1.5 PRIORITY

High

4.2 SOFTWARE

4.2.1 DESCRIPTION

The product shall provide the software required for operation of the camera.

4.2.2 SOURCE

Traffic Net

4.2.3 CONSTRAINTS

None

4.2.4 STANDARDS

None

4.2.5 PRIORITY

High

5 PERFORMANCE REQUIREMENTS

The sections will provide the information about the performance requirements that are necessary for the surveillance camera to perform at the acceptable level. The product should fulfill the certain performance criteria like zooming capacity, power consumption, tilt and rotate at certain angle, etc.

5.1 POWER COMSUMPTION

5.1.1 DESCRIPTION

The camera should operate at the power of 5 watts.

5.1.2 SOURCE

Traffic Net

5.1.3 CONSTRAINTS

The low power consumption lowers the performance.

5.1.4 STANDARDS

None.

5.1.5 PRIORITY

High.

5.2 ZOOMING CAPABILITY

5.2.1 DESCRIPTION

The camera should be able to zoom the object by 10 times

5.2.2 SOURCE

Traffic Net

5.2.3 CONSTRAINTS

The video will not be of high quality.

5.2.4 STANDARDS

None.

5.2.5 PRIORITY

High

5.3 PIXEL AND FRAME RATES

5.3.1 DESCRIPTION

The system shall operate at 520p at 10fps.

5.3.2 SOURCE

Traffic Net

5.3.3 CONSTRAINTS

Poor picture quality.

5.3.4 STANDARDS

None.

5.3.5 PRIORITY

High

5.4 OPERATING TEMPERATURE

5.4.1 DESCRIPTION

The camera should operate between the temperature of range -20 C and 80 C.

5.4.2 SOURCE

Traffic Net

5.4.3 CONSTRAINTS

Performance of the camera.

5.4.4 STANDARDS

None.

5.4.5 PRIORITY

High

5.5 TILT AND ROTATE

5.5.1 DESCRIPTION

The camera should tilt 180 degree and rotate 360 degree.

5.5.2 SOURCE

Traffic Net

5.5.3 CONSTRAINTS

Performance of the camera.

5.5.4 STANDARDS

None.

5.5.5 PRIORITY

High

6 SAFETY REQUIREMENTS

This section will address safety requirements regarding the camera. It will list and describe in detail the precautions that must be taken in order to safely and properly utilize this product. Ensuring that these requirements are properly implemented will assure the safety of all individuals involved.

6.1 CAMERA ENCLOSURE MATERIAL

6.1.1 DESCRIPTION

The material of the camera enclosure must not contain glass. This will provide safety to all individuals from the glass that may break off due to certain weather conditions or other circumstances.

6.1.2 SOURCE

CSE Senior Design project specifications

6.1.3 CONSTRAINTS

The manufacturer must find another material that is satisfactory and enables the safety of the camera and the individuals involved during all circumstances.

6.1.4 STANDARDS

N/A

6.1.5 PRIORITY

Priority 2

6.2 CAMERA INTERIOR PACKAGING

6.2.1 DESCRIPTION

The pieces located inside the camera enclosure must be organized and packaged in a way that prevents cuts from sharp edges or shock. This will ensure that individuals handling the product will not be injured.

6.2.2 SOURCE

CSE Senior Design project specifications

6.2.3 CONSTRAINTS

The manufacturer must find materials and parts used to make the interior component of the camera that will not be able to injure an individual who is touching the material by cutting or shocking them.

6.2.4 STANDARDS

N/A

6.2.5 PRIORITY

Priority 2

7 MAINTENANCE & SUPPORT REQUIREMENTS

This section will address maintenance and support requirements for the camera. It will list and describe in detail the maintenance and support that will be necessary to amend any issues that may occur after the delivery of the product. Maintenance and support requirements regarding both hardware and software components will be provided.

7.1 CAMERA EXTERIOR MAINTENANCE

7.1.1 DESCRIPTION

The exterior of the camera must undergo maintenance semiannually. The exterior must be checked for damage that can occur due to the weather and other sources. If the damage is considered to be significant, then the exterior or the entire product must be replaced.

7.1.2 SOURCE

CSE Senior Design project specifications

7.1.3 CONSTRAINTS

The customer must have technicians available to inspect the status of the camera exterior semiannually.

7.1.4 STANDARDS

N/A

7.1.5 PRIORITY

Priority 3

7.2 CAMERA INTERIOR MAINTENANCE

7.2.1 DESCRIPTION

The interior of the camera must undergo maintenance semiannually. The interior of the camera must be checked for damage. If the damage is considered to be significant, then certain parts or the complete component must be replaced.

7.2.2 SOURCE

CSE Senior Design project specifications

7.2.3 CONSTRAINTS

The customer must have technicians available to inspect the status of the camera interior semiannually.

7.2.4 STANDARDS

N/A

7.2.5 PRIORITY

Priority 2

7.3 SOFTWARE MAINTENANCE

7.3.1 DESCRIPTION

The web interface must undergo maintenance quarterly in order to assure proper functionality. All the functionalities, such as pan, tilt, and zoom must be accessed and tested to verify functionality. The technician who is responsible for the maintenance should be able to view what the camera is pointing towards clearly when testing these functionalities.

7.3.2 SOURCE

CSE Senior Design project specifications

7.3.3 CONSTRAINTS

The customer must have experienced technicians available to check for proper functionality of the camera through the web interface. The technician must also have the user manual and source code documentation to fix any issues that occurred.

7.3.4 STANDARDS

N/A

7.3.5 PRIORITY

Priority 1

8 OTHER REQUIREMENTS

The following includes additional requirements that the project must have, a more detailed description of each requirement, the source, the constraints, the standards, and finally the priority of each standard that the project must have. Although the team does not have to have a final one hundred percent fully professional project by the deadline which is by the middle of March, the requirements set by TrafficNet must be complete.

8.1 REQUIREMENT

Some additional requirement would be to arrange all the components of the project into a professional way, cover any logos of components we might use in our project, modularity and extensibility will be required in case future enhancements might be necessary, camera has to be portable, the graphical user interface must be easy to use and work with any type of operating system.

8.1.1 DESCRIPTION

The project must be done in a professional manner which means that no hanging cables or messy implementation of components. Modularity and extensibility will be required because in case we decide to add to the project in the future, we want to know exactly what each component and connection does, so that in the future implementation will be easier. The camera does have to be portable, which means that the camera must fit on an enclosed spaced and not be too big or have cables running all over the place. The graphical user interface must be easy to use because we don't want the user to get confused about how to interact with the camera.

8.1.2 SOURCE

The source comes from TrafficNet, which they gave us an idea of how the project must be implemented.

8.1.3 CONSTRAINTS

One of the biggest constraints would be for the project to run on not more than 5W of power, which means we must make the project run on very low power and use solar panels to achieve the required amount.

8.1.4 STANDARDS

Extreme low power, must have a solar panel and battery, have pan and tilt capability, heating capability, easy to use GUI, and 10X zoom.

8.1.5 PRIORITY

The top priority would be for the system to run on extreme low power. After the top priority is achieved, the other priorities are as follows, 180 degrees pan and tilt, easy to use GUI, 10X zoom, and finally having a heating capability for extreme weather.

9 ACCEPTANCE CRITERIA

The following will explain the acceptance criteria, the requirements addressed, and finally the verification procedure. As stated in the other requirement section, the team does not have to have a one hundred percent fully professional project complete by the deadline which is by the middle of March, but the project does have to meet with the requirements set by TrafficNet.

9.1 SPECIFY ACCEPTANCE CRITERIA

Verify that the project has all the necessary requirements set by TrafficNet.

9.1.1 REQUIREMENTS ADDRESSED

Some of the requirements that will be addressed would be extreme low power draw, must have a solar panel and battery, have pan and tilt capability, heating capability, easy to use GUI, and 10X day and night zoom.

9.1.2 VERIFICATION PROCEDURE

The acceptance criteria by the deadline will be a visual inspections just to see that the project does have the necessary requirements like, zoom lens, tilt, span, camera chassis, and microcontroller. Once the team does have the final version of the project, a standard verifying test and live demonstration will be used by TrafficNet to actually test all the requirements they had specified, which will then be the acceptance factor of the product.

10 USE CASES

This section is dedicated to specifying UML use cases for the user-visible features specified herein. Included in this section are details addressing administrative or maintenance support users, requirements for setup and installation procedures, as well as "customer end-user requirements."

10.1 WARNING

Installation and servicing should be performed only by qualified and experienced technicians to conform to all local codes and to maintain your warranty.

10.2 SETUP AND INSTALLATION

10.2.1 SCENARIO

It is to be noted that supply, installation and commissioning of the system with all accessories, auxiliaries, and any item not covered in the specification but essential for proper installation, operation and maintenance of the system shall be included and executed by the vendor.

10.2.2 ACTOR(S)

The setup and installation of the camera shall be the responsibility of only a qualified vendor technician.

10.3 CAMERA OPERATION

10.3.1 SCENARIO

The camera shall be accessed via secured web interface. The user shall be required to log on by entering a unique password. A "live view" from the camera shall be displayed on the user monitor during operation. The view shall include pan, tilt, and lens functions (zoom, iris and focus). The user shall possess the ability to remotely control all viewing functionality. The user shall possess the ability to set and clear the movement limits of the pan and tilt mechanisms so equipped.

10.3.2 ACTOR(S)

The use and operation of the camera shall be at the discretion of the administrator and/or user operator.

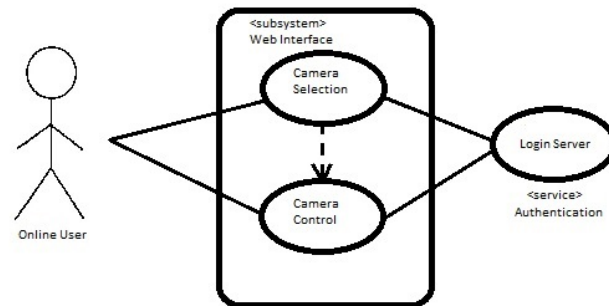
10.4 ADJUSTING THE CAMERA

10.4.1 SCENARIO

The camera shall be adjustable in all features relating to viewing functionality remotely. The camera shall be adjustable in all features relating to viewing functionality manually on location.

10.4.2 ACTOR(S)

The remote adjusting of all viewing features shall be at the discretion of the administrator and/or user operator. The manual adjusting of all viewing features shall be the responsibility of only a qualified vendor technician.



10.5 ROUTINE MAINTENANCE

Scenario It is to be advised that routine maintenance be performed both remotely and on location weekly and annually, respectively. Routine maintenance shall incorporate on location inspections of camera conditions, including the cleanliness of internal systems and the working condition of component connections. Routine maintenance shall incorporate remote inspections of camera feature functionality, including the pan, tilt, zoom and focusing features.

10.5.1 ACTOR(S)

Routine remote maintenance shall be expected to be performed weekly at the discretion of the administrator and/or user operator. Routine on location maintenance shall be expected to be performed annually at the discretion of only a qualified vendor technician.

11 FEASIBILITY ASSESSMENT

This section consists of an assessment of the following six components: scope analysis, research completed/remaining, technical analysis, cost analysis, resource analysis and schedule analysis in an attempt to critically analyze the feasibility of the successful fulfillment of the requirements specified herein.

11.1 SCOPE ANALYSIS

The scope of work for all critical requirements is reasonable, but the prototyping of these by the deadline date may be the most challenging aspect of this project. This team is confident however in their ability to fulfill even this most challenging element. This assessment is based on the research undergone and an understanding of the project completion requirements, as well as the experience provided this team by Dr. Christopher McMurrugh, who has been instrumental in aiding their progress thus far. This team anticipates that three of the most crucial requirements will comprise the bulk of the work scope. These are . Furthermore, it can be confidently stated that the addition of all remaining high priority criteria contributes little to the full scope of work for this project, so the probability of completing these remains high.

11.2 RESEARCH

With regards to this project, team research has spanned a broad spectrum of topics relative to the work scope associated with the project requirements. Thus far this team has reviewed one closely similar open source project by Sons of Tone which accomplished, relative to the project requirements stated here, a working full HD IP camera based on Raspberry Pi. In addition to this however, they have seen fit to research several topics not covered in the previous source. These topics include...

11.2.1 WHEN TO USE IR CORRECTED LENSES

A white paper provided by PELCO Worldwide Headquarters discusses when and how to effectively use IR corrected lenses for day/night cameras.

11.2.2 TECHNICAL GUIDE FOR LENSES

A technical guide for cctv lenses provided by Computar with information about auto v. manual iris, video v. DC drive, C v. CS mounting and IR lense functionality.

11.2.3 REMAINING RESEARCH

In addition to the sources listed herein, this team has ongoing research efforts dedicated to stepper motor control software and, in the near future, will be expanding their research efforts into higher end camera lenses such as the PELCO 13ZD6X10.

11.3 TECHNICAL ANALYSIS

The envisioned product is not aimed at delivering state of the art technology to the intended field of deployment. This team has been tasked with the development of the best possible product within a specific range of operating constraints. Therefore, the most technically valuable aspects of this project revolve around a venn diagram consisting of cost effectiveness, power efficiency, and durability. Additionally, this team is in competition with a product already in consideration for deployment, providing them a baseline of technical specifications which to improve upon. Given these factors, producing a competitive product is not only feasible, but highly probable.

The question of industry experience needed in developing products of this nature is void, as this team is comprised of a group of inexperienced developers. To compensate, Dr. McMurrugh has provided this team with direction when necessary. Excluding his involvement in the development process however, the technical skills necessary to the successful completion of this project which are beyond the skillset

of this team remain undiscovered. Those general technical skills which have been learned and utilized thus far include wireless communication, web interfacing, motor control, and power management.

The above listed skills have been honed by this team largely thanks to some key tools employed in the development of the project prototype. Notably the Raspberry Pi, the Raspberry Pi Camera Module, and the adapters associated with them. The diversity of these tools has effectively allowed this team to conduct tests and learn about the technical nature of their project in rapid succession.

11.4 COST ANALYSIS

Upon the drafting of this document, the prototype remains unfinalized. However this team has not yet committed even one tenth of the available budget to the work currently undergone. They are, at present, within the last quarter of their allotted development time and therefore can be reasonably expected to finish the project prototype with the remaining budget.

11.5 RESOURCE ANALYSIS

As previously stated, this team is comprised of a group of inexperienced developers. As such, their skillset is currently under evaluation based upon the performance of their final product. Many of the skills needed to successfully complete the development of this project are being learned at the very same time as they are being utilized throughout the development process. However, those skills such as programming the Raspberry Pi .dts files have been successfully employed by this team. Therefore it is not unreasonable to expect that any remaining skills necessary to the successful completion of this project but not already engaged by this team can and will be honed in order to deliver a complete and professional product.

11.6 SCHEDULE ANALYSIS

In order to complete the requirements stated herein within the allotted time, this team has employed the use of three key tools and or methodologies to remain punctual. The mobile device application GroupMe has allowed this team to remain in contact to the specific effect of addressing any and all concerns outside of face to face meetings, saving us an abundance of time and effort. Additionally, The use of the scrum meeting archetype and burndown charts while engaged in scrums has afforded this team the opportunity to effeciently gauge their progress thus far in product development.

12 FUTURE ITEMS

This final section is a concise statement of features/functions that were considered/discussed and documented herein, but will not be addressed in the prototype version of the product due to constraints of budget, time, skills, technology, or feasibility analysis.

12.1 MAINTENANCE AND SUPPORT REQUIREMENT 7.1: CAMERA EXTERIOR MAINTENANCE

12.1.1 DESCRIPTION

The exterior of the camera must undergo maintenance semiannually. The exterior must be checked for damage that can occur due to the weather and other sources. If the damage is considered to be significant, then the exterior or the entire product must be replaced.

12.1.2 SOURCE

CSE Senior Design project specifications

12.1.3 CONSTRAINTS

The customer must have technicians available to inspect the status of the camera exterior semiannually.

12.1.4 STANDARDS

N/A

12.1.5 PRIORITY

Priority 3

12.2 MAINTENANCE AND SUPPORT REQUIREMENT 7.2: CAMERA INTERIOR MAINTENANCE

12.2.1 DESCRIPTION

The interior of the camera must undergo maintenance semiannually. The interior of the camera must be checked for damage. If the damage is considered to be significant, then certain parts or the complete component must be replaced.

12.2.2 SOURCE

CSE Senior Design project specifications

12.2.3 CONSTRAINTS

The customer must have technicians available to inspect the status of the camera interior semiannually.

12.2.4 STANDARDS

N/A

12.2.5 PRIORITY

Priority 2

12.3 MAINTENANCE AND SUPPORT REQUIREMENT 7.3: SOFTWARE MAINTENANCE

12.3.1 DESCRIPTION

The web interface must undergo maintenance quarterly in order to assure proper functionality. All the functionalities, such as pan, tilt, and zoom must be accessed and tested to verify functionality. The technician who is responsible for the maintenance should be able to view what the camera is pointing towards clearly when testing these functionalities.

12.3.2 SOURCE

CSE Senior Design project specifications

12.3.3 CONSTRAINTS

The customer must have experienced technicians available to check for proper functionality of the camera through the web interface. The technician must also have the user manual and source code documentation to fix any issues that occurred.

12.3.4 STANDARDS

N/A

12.3.5 PRIORITY

Priority 1

REFERENCES