Pioneer Solutions

March 2, 2009

Mr. Patrick Leung
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440/305 Pet Care System Design Specifications
Dear Mr. Leung:

Please find attached the document, Pet Care System Design Specifications; this document outlines the design specifications of our project for ENSC 440/305.

The goal of Pioneer Solutions is to design a system that will allow a pet owner to take care of his/her pet away from home via a webpage. The system will involve multiple components that will assure the pet's health for an extended duration.

The design specifications described in this document apply to the prototype. In addition to the prototype design specifications, improvements for future iterations of the Pet Care System are discussed, but will not be implemented in this stage of development. In the end, we expect a product to be completed by April 17th, 2009 that reflects the design specifications highlighted in the attached document.

If you have any questions or concerns about our design specifications document, please feel free to contact me by phone at (604) 313-2981 or by e-mail at kwinkelm@pioneersolutions.ca.

Sincerely,

Kyron

Kyron Winkelmeyer
Project Manager
Pioneer Solutions

Enclosure: *Pet Care System Design Specifications*

Pioneer Solutions

Pioneer Solutions

Pet Care System

Design Specifications

Version 1.4

2nd March, 2009

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Executive Summary

The design specification for the Pet Care System (PCS) provides an extensive list of detailed descriptions for the design and development of the prototype that is scheduled for completion by April 17th, 2009. The design considerations that will be discussed pertain to the functional requirements, as specified in the document *Pet Care System Functional Specifications* [1]. In addition to the current design specifications, design improvements for future iterations of the Pet Care System will also be discussed.

The following document will discuss in detail the selection, modification, and integration of components that will produce the final working prototype at the end of the development cycle. As discussed in the functional specifications document, the Pet Care System will be comprised of a development board, camera, food dispenser, water dispenser, and gate.

In addition to the design specifications, a description of test plans for the overall system, as well as the subcomponents, is provided at the end of the document.

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Acronyms

AC – Alternating current

API - Application programming interface

DC – Direct current

EMI – Electromagnetic interference

IEC – International Electro-technical Commission

IO pins – Input/output pins

IR – Infrared

LCD – Liquid crystal display

LED – Light-emitting diode

OS – Operating system

PCS – Pet Care System

RISC – Reduced instruction set computer

USB – Universal serial bus

Glossary

AC to DC Adapter – A device that converts the household current AC to the DC current that is used in most electronics.

Application programming interface – A set of routines, data structures, object classes and/or protocols provided by libraries and/or operating system services in order to support the building of applications [9].

H-Bridge – An electronic circuit which enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards [3].

IEC 60228 – International Electrotechnical Commission's international standard on conductors of insulated cables [4].

JavaScript – A scripting language heavily used for client-side web development.

Server – A computer program that provides services to other computer programs (and their users), in the same or other computer. The physical computer that runs a server program is also often referred to as server [7].

Stepping Motor – A brushless, synchronous electric motor that can divide a full rotation into a large number of steps. The motor's position can be controlled precisely, without any feedback mechanism (see open loop control) [2].

Qtopia – An application platform for embedded Linux-based mobile computing devices such as mobile phones.

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1. Introduction

The Pet Care System (PCS) will enable user(s) to take care of their pet from anywhere that has internet access. The system that Pioneer Solutions will deliver involves multiple components to assure that all essential facets of a pet's welfare are managed. The subsequent sections in this document give an extensive list of the design specifications both the overall system and the individual components must possess. All specifications are expected to be covered in the prototype that will be demoed at the end of the project development cycle.

Purpose

The purpose of the design specifications is to compile a record of designs and explain how these designs meet the functional requirements described in the document *Pet Care System Functional Specifications* [1]. In addition, the design specifications document outlines future considerations in improving the design of the PCS.

Audience

Members of Pioneer Solutions are the intended audience of the design specifications document. Design engineers will utilize the design specifications document as a guideline in meeting the functional requirements of the prototype system. Test engineers will utilize the design specifications document to implement test plans; these test plans will validate the conformity of the prototype with the functional requirements.

2. System Specification

The PCS will create a bi-directional communication interface with the user(s) via the internet in ensuring the well being of the pet residing in the users' residence. The well being will be ensured by the food dispenser, water dispenser, gate, and camera. These components are considered subcomponents of the PCS and will be controlled by the development board. The development board's actions will be controlled by a webpage. The operations of the PCS will be based on an automated state or a manual state; the state/mode of the PCS will be selected by the user via the webpage.

The automated mode of the PCS will be the scenario whereby the subcomponents of the system are controlled on a user defined basis. The user will log on to the webpage and select the time of the day at which the subcomponents will be activated. Following the confirmation of the schedule, as well as the selection of the automated mode, the PCS will activate the subcomponents of the system at the times defined by the user as long as there are no major malfunctions with the respective subcomponent. The activation of the subcomponent is dependent on the internet connection speed/latency as well as the mechanical movement of the subcomponent.

The manual mode of the PCS will be the scenario whereby the subcomponents of the system are controlled by the user whenever he/she decides to activate them. The user will log on to the webpage and will click a button and activate the respective sub component. Following confirmation of the request, the PCS will activate the desired sub component of the system as long as there are no major malfunctions with the respective sub component. The activation of the subcomponent is dependent on the internet connection speed/latency as well as the mechanical movement of the subcomponent.

3. Overall System Design

The following section will provide a high-level design overview and will focus on common design aspects between the components of the PCS. Due to the design inconsistencies between the subcomponents, most of the design information will be in subsequent sections of this report.

System Communication Design

The bi-directional nature of the PCS requires the user(s) to control the subcomponents of the system as well as the subcomponents of the system to provide information to the user(s).

Figure 1 is the forward communication scheme between the user and the subcomponents of the PCS. The user(s) will interact with a webpage and this information will be stored on the webpage server. This server is hosted on the development board; based on the users' input/interaction of the webpage, the development board will control its output pins. These pins will control the operation of the food dispenser and gate.

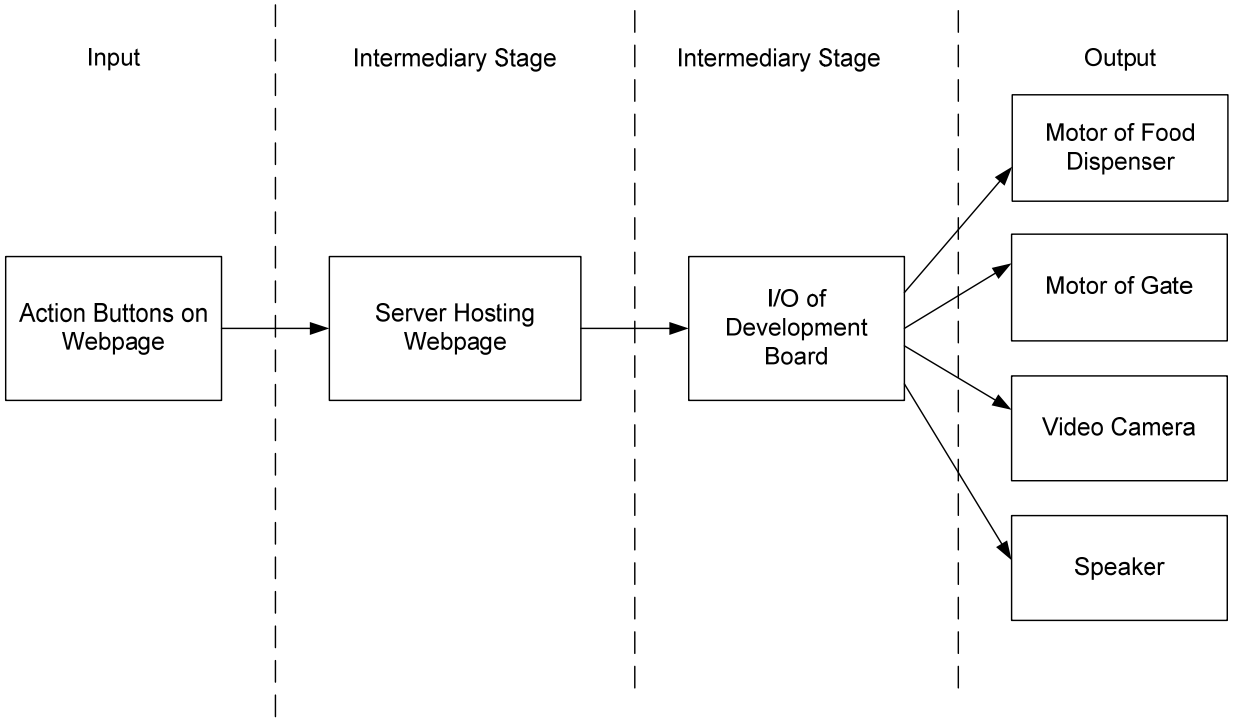

Figure 1: PCS Forward Communication Scheme

Figure 2 is the backward communication scheme between the user and the subcomponents of the PCS. The subcomponents will have various inputs regarding their welfare as well as other information. This information is sent to the development board via the input pins. The development board reads this information and updates the webpage via the webpage server that is hosted on the development board. Following the updating of the webpage, the user(s) will have up to date knowledge on the PCS.

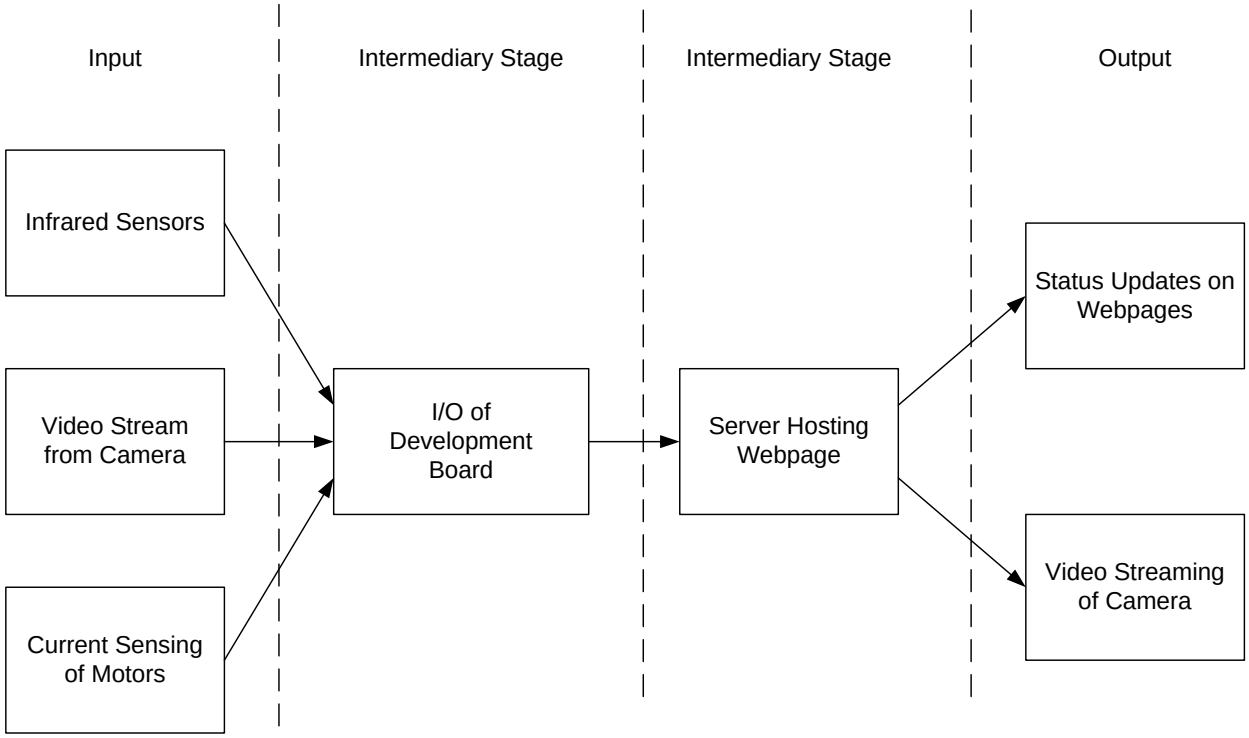

Figure 2: PCS Backward Communication Scheme

Mechanical and Physical Design

The mechanical features of the system are solely stepper motors. The camera, food dispenser, and gate have functionalities that depend on the stepping motor's capability of providing torque with an electrical input. The torque needed for each aforementioned subcomponent is unique; therefore, different motors are warranted.

Stepping motors were chosen for three reasons. The first reason was due to the fact that the development board needs to control the subcomponents that utilize a motor; therefore, a motor that could be powered with an electrical current was required. The second reason was due to the fact that some of the subcomponents, specifically the camera and food dispenser,

require the motor to divide a rotation into steps. The third reason was due to the fact that other motors require an H-Bridge for control; eliminating the need for an extra piece of hardware makes the design simpler and more cost efficient.

Further information regarding the motors for the camera, food dispenser, and gate are provided in their respective sections.

The noise of the PCS will be caused by the motor and its load (i.e. moving parts). In consideration of the residents that may be within the residence at the time of operation, the PCS will feature the following designs to mitigate any noise:

- All subcomponents of the system will be enclosed in a wooden structure with insulation that will limit the noise of the system to 40dB or lower (see R13 – II).
- All moving pieces' contact with either each other or the structure of the subcomponent will be limited through the user of sliding or rolling mechanisms that will limit the kinetic friction coefficient.
- Shielding of EMI noise from motors.

All subcomponents, except for the camera, will have a physical enclosure. All physical enclosures will be made as small as possible while still meeting the functional requirements; the size and shape of the enclosures will be such that they can fit flush against a wall. The physical enclosures for the prototype will be made out of wood, as that is the cheapest and easiest resource available to Pioneer Solutions. In addition, wood satisfies the environmental functional requirements, specifically:

- Operating under normal resident temperatures (15 - 30°).
- Operate in an indoor setting.

Electrical and Power Supply Design

The PCS components will be connected by 2.5mm² copper wiring. Figure 3 illustrates a schematic of the electrical connections of the system. The wire is connected between the development board and the subcomponent it is controlling. Multiple wires are needed for each subcomponent; the breakdown of wires and their purpose will be given in subsequent design specifications.

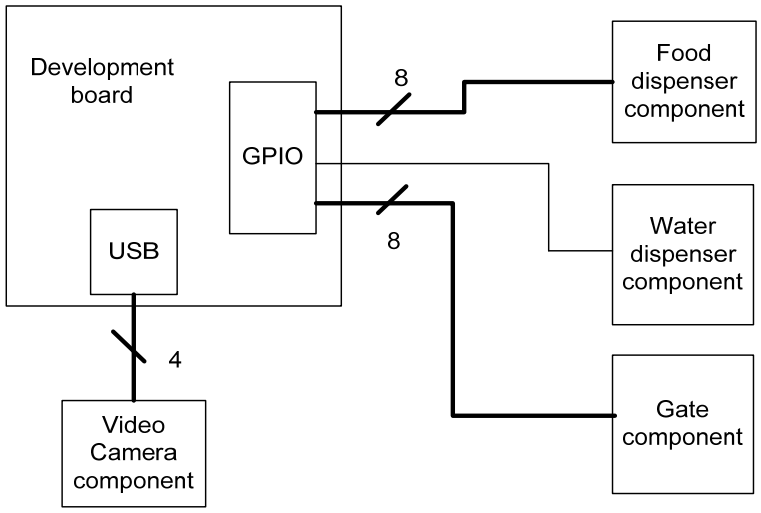

Figure 3 Simplified circuit schematic for overall system connection

Copper wire was chosen due to its standard use in electrical systems as well as its electrical conductivity. The diameter of the wire was chosen based on IEC 60228. The copper wire will be rubber-insulated with a flexible metal sheath. The flexibility of the wiring will allow the technician to install the PCS and the wiring without being constrained.

An AC power source is required to power the development board. The PCS will utilize the common household electrical infrastructure in acquiring the AC power source.

Multiple DC power sources are required to power the subcomponents of the PCS, specifically the food dispenser and gate. The DC power source will be acquired through the use of an AC to DC adapter where the AC power source will be again provided through the household electrical infrastructure. The adapter will be specified in subsequent sections.

The following power requirements of the PCS must be met:

- Maximum current: 5A
- Voltage: 24V dc, 12V dc
- Can be run from a wall electrical outlet
- AC to DC conversion

The maximum current is calculated by adding up the maximum current requirements for all components plus some safety margin current, which end up a maximum current of 5A. The 24V

dc is used for supplying all the motors, while the 12V dc is used for supplying the development board and all sensors.

The only significant safety considerations of the PCS are with respect to the electrical and power supply design. Due to these considerations, there are several safety features that are built into the PCS; these features are listed below:

- Use of current sensing circuitry in motor related circuits.
- Proper insulation of wires

The use of current sensing circuitry is perhaps the most significant consideration. Due to the heavy reliance of motors, there is a probability that the scenario, whereby the motor will try to drive an unmovable load, will occur. The issue with this scenario is that not only will the motor sustain damage but the heat generated from the current may cause a fire in the physical enclosure.

The insulation of wires is also critical to the safety of the PCS and its user(s). Proper insulation will prevent electrical fires.

4. Webpage and Server Design

The development board shall host a webpage and a server that will act as an intermediary between the user and the devices (i.e. camera, food dispenser, water dispenser, and gate) that assure the pet's health. Due to the hard deadline of the project, the prototype will feature only the development board with pre-installed server and webpage features.

Physical and Electrical Design

The development board that will be used is the FS2410 from UC Dragon [5]. The noteworthy specifications of this board are:

- 12V dc input
- Maximum 600mA current draw
- Samsung's S3C2410 16/32-bit RISC microprocessor running at 203 MHz
- 64MB RAM and 64MB NAND Flash memory
- 10M Ethernet connector
- Audio output and input jacks
- LCD touch screen connector

The FS2410 has all necessary built-in connectors such as USB, serial port, audio, Ethernet, etc. These built-in connectors simplify a majority of the soldering work. In addition, this particular development board was chosen due to the fact that it was already in possession of Pioneer Solutions; therefore, a significant cost was avoided. A picture of the development board is shown in Figure 4.

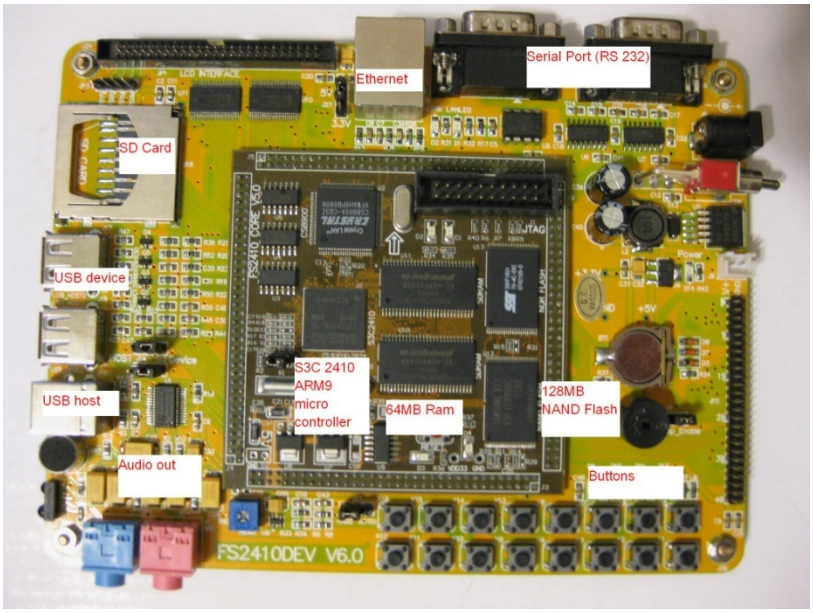

Figure 4 FS2410 Development Board

Several wires will be soldered to the pins of the development board. These wires are connected to the camera, food dispenser, water dispenser, and gate of the PCS.

The development board will utilize a Linux OS. More specifically, Qtopia will be the distribution of Linux being used, based on the Linux 2.6.8 kernel. The rationale behind programming in Linux is that the source code being used for this board is abundant. In addition, the software engineers' experience comprise mostly of programming on Linux operating systems.

The development board will also feature a LCD touch interface. This interface will be useful for technicians in diagnosing problems with the board, server, or webpage.

The development board is essential to the performance of the PCS; therefore, protection from physical damage is required. As previously mentioned, the development board will be housed in a wooden enclosure. The enclosure is illustrated in Figure 5.

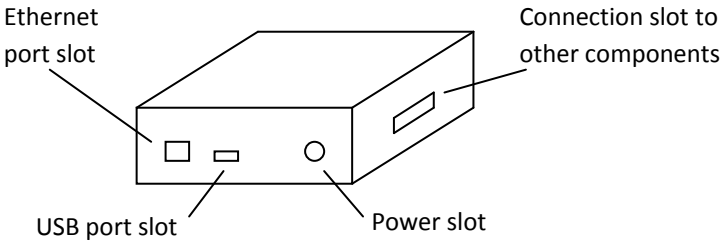

Figure 5 Overview of development board enclosure

Webpage Server Design

The webpage will act as the interface between the user and the PCS. Through the webpage, the user will be able to activate the subcomponents (i.e. camera, dispensers, and gate) of the PCS. The actions that will be displayed on the webpage are included in Table 1; the status alerts that will be displayed on the webpage are included in Table 2.

Action	Description
Set Operation Mode	Allows the user to choose manual or automated mode.
Set Food Dispensing time	Allows the user to set the times of the day that the pet will be fed.
Set Gate Lock/Unlock time	Allows the user to set the times of the day that the gate will be unlocked.
Set Command times	Allows the user to set the times of the day that an audible command will be given.
Dispense Food	Allows the user to manually dispense food.
Unlock Gate	Allows the user to manually unlock gate.
Lock Gate	Allows the user to manually lock gate.
View Pet	Allows the user to watch their pet via a camera.
Play Command	Allows the user to play a pre-recorded command.

Table 1 Action Buttons on PCS Webpage

Status/Alert	Description
Food Level	Displays a red flag in the event that a low amount of food is left. Green flag otherwise.
Water Level	Displays a red flag in the event that a low amount of water is left. Green flag otherwise.
Gate Condition	Displays “Locked” or “Unlocked”
Food Dispenser Motor Condition	Displays a red flag in the event that the motor is not operating properly. Green flag otherwise.
Gate Motor Condition	Displays a red flag in the event that the motor is not operating properly. Green flag otherwise.

Table 2 Status/Alerts of PCS Webpage

Due to the growing trend of people using their mobile phones to access the internet [6], the PCS webpage will be mobile friendly. The webpage will be built using HTML and JavaScript. For the prototype, this webpage will be static, or in other words, the webpage will not have the ability to be altered by the user and will have the predefined actions and status alerts as listed in Table 1 and 2. JavaScript commands will be used to operate all of the PCS functions as well as getting the required status reports from all the components.

The server for the webpage will be run on the development board and will function as follows:

- The server will be running in a multithreaded environment; every time a request is received by the server, a new thread will be generated to handle the request.
- Upon receiving the request, the server will determine the corresponding action to take on the server machine (development board), and the corresponding return message.
- Since the controlling is done via the client webpage, JavaScript will be used to do the actions and obtain the statuses of the system components, as mentioned previously.

Due to the performance specifications of the development board, the server will be given a design that doesn’t require significant responsibility with respect to the magnitude of tasks it will perform. The server's role will be to carry out the commands generated by the client, and the client will be responsible perform tasks that require significant overhead, such as the processing of images.

Server Software Design

JavaScript is being used for controlling the actions and obtaining the statuses of the system; therefore, functions than can be called to handle all of these components will be needed. This requirement will be implemented through separate C programs to handle each component and in each program there will be multiple functions to handle each task the component needs to do. A driver will be implemented to gain access to the IO pins as these IO pins are used to control the motors and sensors. The camera will be accessed through a USB port, and while a driver for the camera access is already available, the camera application will need to provide a simpler API than the one provided, thus the design team will be creating a proprietary driver for the camera.

5. Gate Design

The gate's function is to allow the pet outside to exercise. It is important that the pet is able to get back inside; however, it is equally important that the gate can prevent the pet from going outside if the conditions are not suitable.

Mechanical and Physical Design

The gate will feature a wooden enclosure. The gate will operate as a bi-directional swinging door that can be pushed open by the pet from either side of the door leading to the outside of the residence. Figure 6 and 7 illustrates the design of the gate. All measurements are in centimeters.

1:5

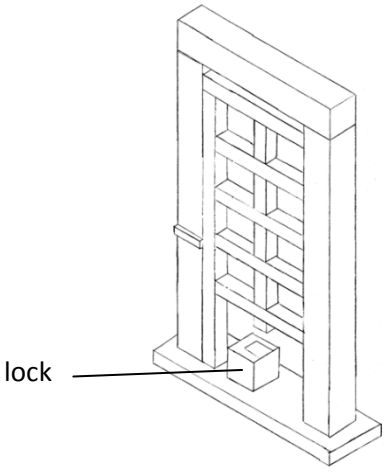

Figure 6 Overview of the gate

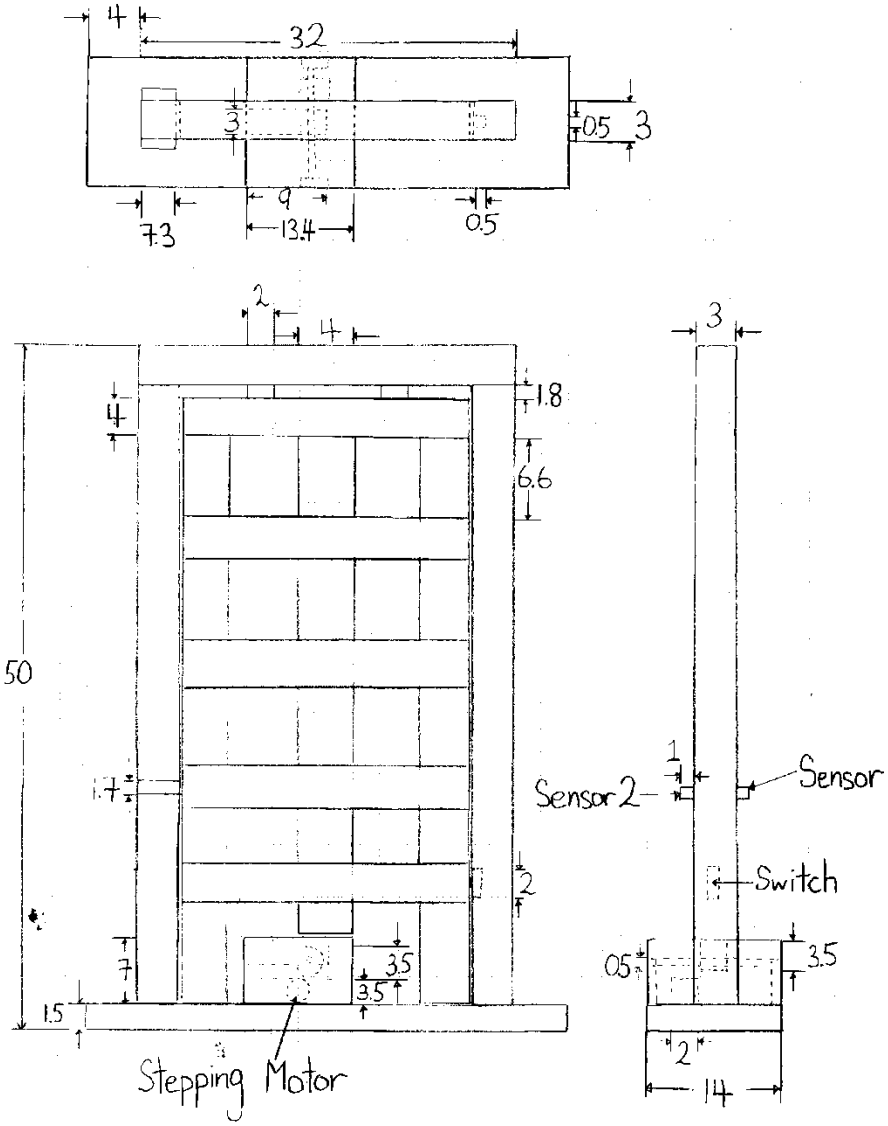

Figure 7 Structural view of the gate

The gate dimensions are summarized in Table 3.

Gate	Absolute Dimension (cm)
Height	50
Width	40
Length	14

Table 3 Gate Dimension

It should be noted that the prototype that will be demoed at the end of the development cycle will feature a gate that is suitable for a 90kg dog. The aforementioned dimensions of the gate are reflective of this goal.

The major mechanical piece of the gate device is the OKI stepping motor. This motor has the following characteristics:

Required Voltage	24 V dc
Current Draw	200 mA
Resistance	117 Ω
Step Precision	7.5 deg/step

Table 4 Characteristics of OKI stepping motor

The rationale for using this motor is foremost that it was already in the possession of Pioneer Solutions; therefore, no expenditures were needed to utilize in the PCS. Secondly, the motor provides the required torque to drive the locking mechanism.

Electrical Design

The motor will be controlled via four wires connected to the development board. The schematic of the stepper motor driver on the gate side is illustrated in Figure 8.

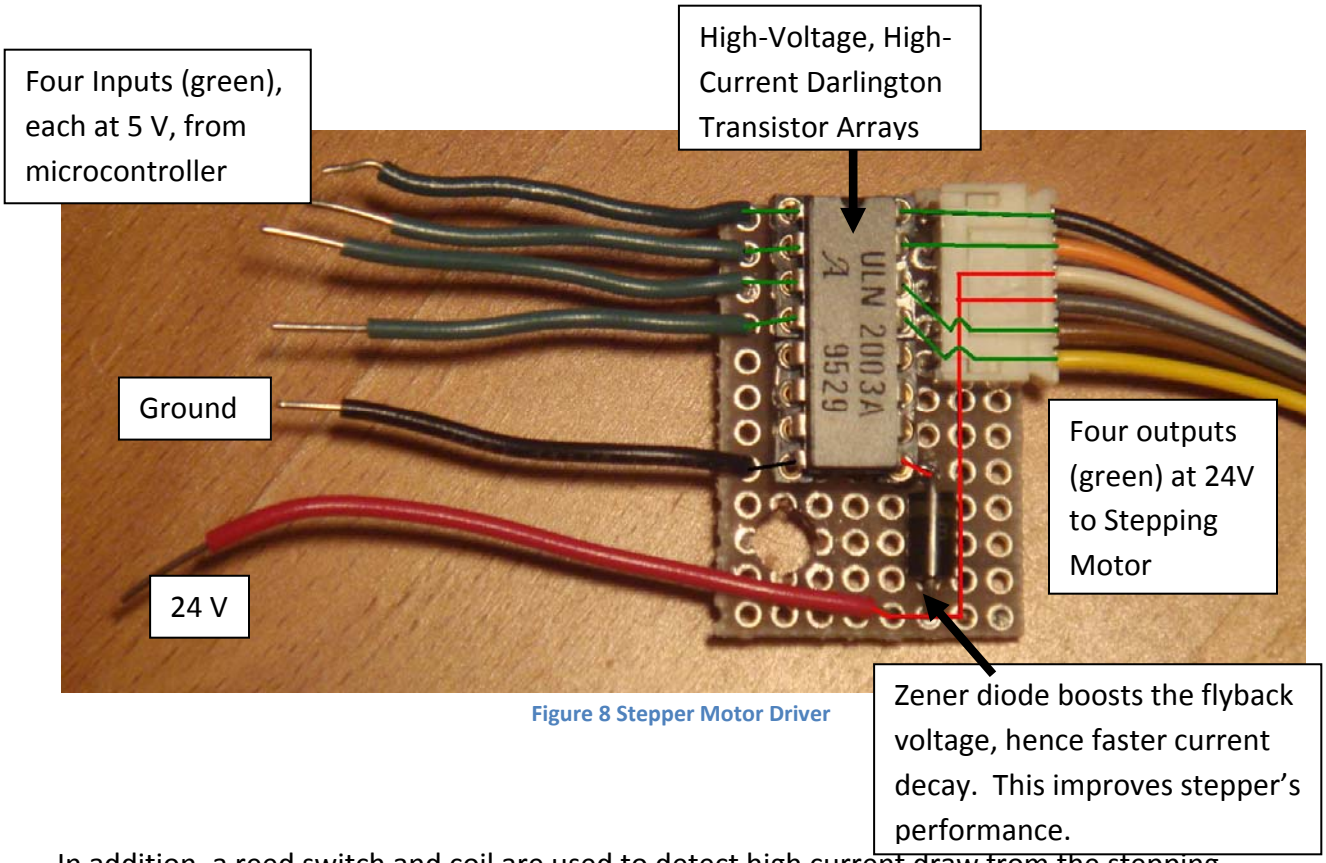

Figure 8 Stepper Motor Driver

In addition, a reed switch and coil are used to detect high current draw from the stepping motor in the event of an obstacle resulting in maximum torque at zero revolution per minute. The coil is wrapped around and across the reed switch; the current sensitivity of the reed

switch is directly proportional to the number of windings in the coil. A miniature-glass reed switch is chosen for our design because this type has no extra casing which decreases the switching sensitivity. The schematic of the setup is shown in Figure 9. The principle behind the reed switch is as follows: if the current draw from the motor is higher than some threshold (determined by the number of winding in the coil), then the reed switch will close and output a logic ground to the controller, otherwise it outputs logic **Vcc**. It should be noted that in Figure 9 the coil and the reed switch appear to be isolated; however in practice, the coil is actually wound around and across the reed switch body.

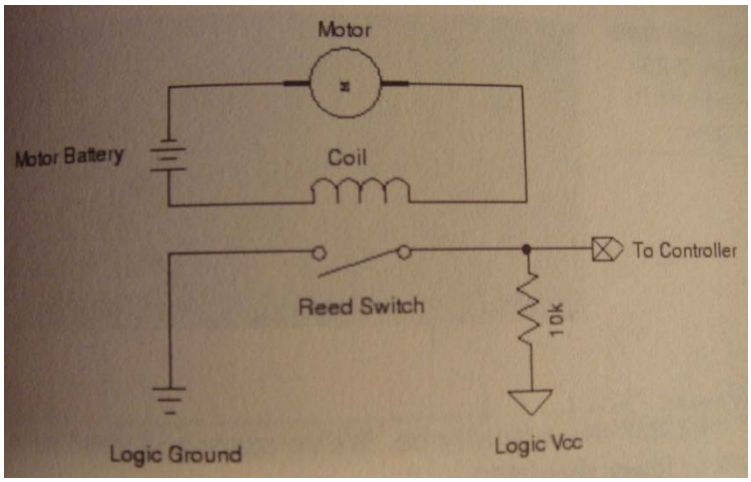

Figure 9 The Reed Switch and Coil Method

Photoelectric sensors at positions indicated by Figure 7 will update the position of the pet with respect to if it is outside or inside. The photoelectric sensors used are Perfect Prox diffuse reflective sensors and their noteworthy specifications are listed below:

Input Voltage	10 to 30 V dc
Power Dissipation	1 W maximum
Output Type	NPN and PNP (dual outputs)
Surge Current	1 A maximum
Response Time	1 ms
Indicator LED	Lights steady when output is ON; Flashes when short circuit protection is in latch condition

Table 5 Comet Photoelectric Sensor Specification

The unique characteristics of the Perfect Prox Photoelectric sensor offer several convincing benefits. The sensor operates by emitting a bean of infrared light out through the one of the two lenses. When an object comes within the sensor's detection zone, it reflects part of this bean of light back to the sensor through the other lens causing the sensor to detect the object. The advanced optics and high power of the Perfect Prox allow the sensor to consistently detect an object at or below maximum range regardless of the object's color or texture. The sensor

has a desirable maximum range of 19.05 cm, which is well above our required range for the purpose of detection as the pet passes through the gate. In addition, the sensor has a unique ability to ignore objects just outside the maximum range (also known as the cutoff range).

The information obtained from the photoelectric sensors will be sent to the development board via a wire.

The DC power source used to power the gate will be obtained from the electrical infrastructure of the house via an AC/DC converter. The converter that will be utilized is the RP-2401A-P AC to DC adaptor which has the following specifications:

Output Voltage	24 VDC
Output Current	1000 mA
Output Connector and type	2.1 x 5.5mm Coaxial Plug
Polarity	Centre Positive

Table 6 RP-2401A-P AC to DC adaptor Specification

General Design

A lock on the gate, as seen in Figure 6, will move into position when the user(s) do not wish for the pet to go outside. This locking mechanism will be controlled by the motor and will rotate into its final position. Conversely, when the user(s) find it suitable for the pet to go outside, the lock will move into the unlocked position, via the motor, from which the pet can push the gate open.

The photoelectric sensor, along with an algorithm on the development board, will monitor the position of the pet, with respect to if it is inside or outside.

6. Food Dispenser Design

As discussed in *Pet Care System Functional Specifications* [1], dogs and cats will be the focus of the prototype; therefore, the food dispenser will only cater to food eaten by these animals. Furthermore, the dispenser will only focus on food that is of a hard consistency.

Mechanical and Physical Design

The food dispenser will feature a wooden enclosure. The food dispenser will feed the pet through the utilization of a motor that will drive a circular dish. Figure 10 and 11 illustrates the design of the food dispenser.

1:5

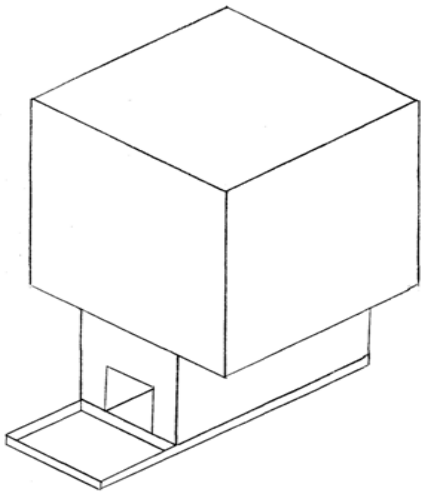

Figure 10 Overview of food dispenser

The food dispenser dimensions are summarized in Table 7.

Food Dispenser	Absolute Dimension (cm)
Height	33
Width	20
Length	27.5

Table 7 Food Dispenser Dimension

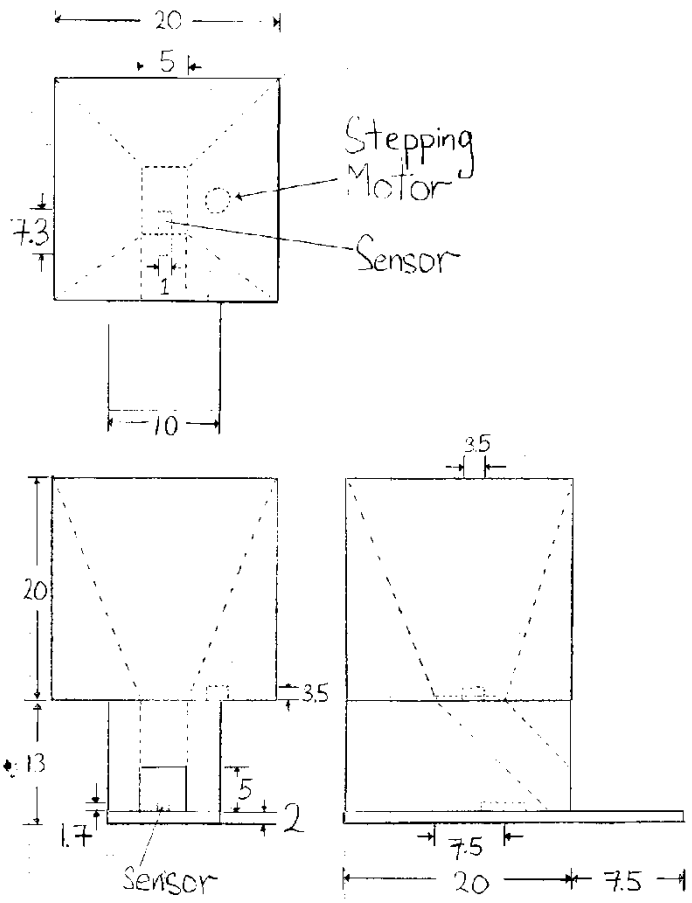

Figure 11 Structural view of food dispenser

The major mechanical piece of the food dispenser device is the OKI stepping motor, which is the same as the motor used for the gate. This motor has the characteristics shown in Table 4.

The rationale for using this motor is foremost that it was already in the possession of Pioneer Solutions; therefore, no expenditures were needed to utilize in the PCS. Secondly, the motor provides the required torque to drive the feeding mechanism.

In addition to the motor, a pair of 2W speaker will be placed closed by the food dispenser as an indication of food dispension.

The speakers do not need any power supply. The audio chip on the development board should be able to drive the 2W speakers.

Electrical Design

The motor will be controlled via four wires connected to the development board. The schematic of this connection on the gate side is illustrated in Figure 8.

In addition, a coil and reed switch will be utilized to measure the current being supplied to the motor.

The photoelectric sensors at the position indicated by Figure 11 will update the quantity of food left in the dispenser. The photoelectric sensor used is a Perfect Prox diffuse reflective sensor and its noteworthy specifications are listed in Table 5.

The purpose for using a photoelectric sensor is to detect if there is still food left in the food dispenser pan. This idea behind this feature is to prevent the user from over feeding the dog.

The information obtained from the photoelectric sensors will be sent to the development board via a wire.

The DC power source used to power the food dispenser will be obtained from the electrical infrastructure of the house via an AC/DC converter. The converter that will be utilized is the RP-2401A-P AC to DC adaptor which has the specifications listed in Table 6:

General Design

The food is dispensed via an opening, which can either be open or closed. If the opening is open, then the force of gravity will pull the food into the food pan and the dog will be fed. To stop the food from dispensing, the user will command the motor via the user interface to close the opening and hence no food is dispensed.

The photoelectric sensor, along with an algorithm on the development board, will monitor the quantity of food left in the dispenser.

7. Water Dispenser

As discussed in *Pet Care System Functional Specifications* [1], dogs and cats will be the focus of the prototype; therefore, the water dispenser will only cater to an apparatus that can be used by these animals.

Physical and Mechanical Design

The water dispenser will be comprised of a wooden structure, as shown in Figure 12 and 13.

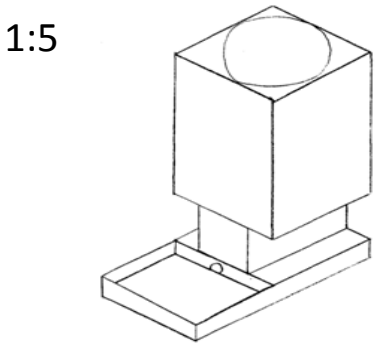

Figure 12 Overview of water dispenser

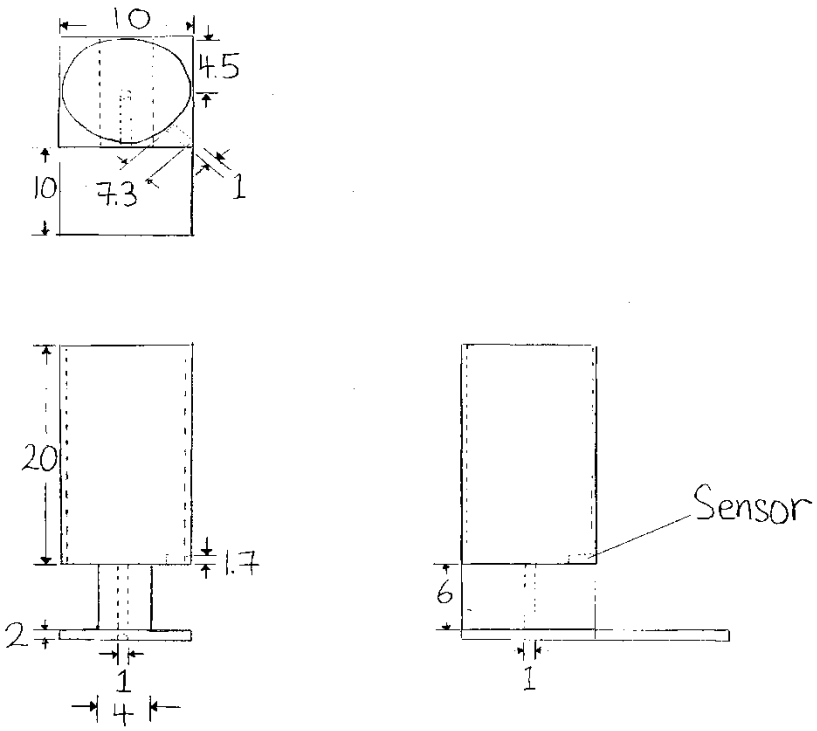

Figure 13 Structural view of water dispenser

The dimensions of the water dispenser are listed in Table 8.

Water Dispenser	Absolute Dimension (cm)
Height	28
Width	10
Length	20

Table 8 Water Dispenser Dimension

Electrical Design

The sole electrical part of the water dispenser is the photoelectric sensor that is placed in the water dispenser to measure the quantity of water remaining.

The photoelectric sensor used is Perfect Prox diffuse reflective sensor and its noteworthy specifications are listed in Table 5.

The purpose of using a photoelectric sensor for the water dispenser is to monitor the water level in the dish as to prevent the user from over dispensing water.

The photoelectric sensor will be connected to the development board via an electrical wire. And the DC power source used to power the water dispenser(sensor) will be obtained from the development board since they both share the 12V dc power supply.

General Design

The water dispenser has an efficient and simple design. As long as the water dispenser has water, the dish will always be filled with water. As the pet drinks water from the dish, the water level will decrease. If the water level is lower than the water hole from the water dispenser, then water will dispense into the dish. However if water level in the whatever pan is higher than the water hole, then the water from the water dispenser will not be dispensed into the dish.

The water dispenser doesn't utilize any moving parts. The dispenser will contain enough water to hydrate the pet for a week. The dish will be kept at a constant level by means of water pressure.

The information in regards to the water level inside the dispenser is provided to the user via a "low water level" indicator. In other words, when the water in the dispenser is 80% empty, the "low water level" indicator lights up in the user interface.

The photoelectric sensor, along with an algorithm on the development board, will monitor the quantity of water left in the dispenser.

8. Camera Design

The camera will provide the user(s) a visual surveillance of their pet; therefore, its function will not assure the welfare of the animal in the same sense as the other components mentioned.

Physical and Mechanical Design

The camera will not have a physical enclosure, unlike the other subcomponents of the PCS. The view of the camera may be obstructed easily if an enclosure were to be used.

The camera can be mounted anywhere as long as the camera cable can reach. For our system prototype, the camera will be placed close to the development board for demonstration purpose.

Electrical Design

The camera that will be utilized in the prototype will be the Creative Labs WebCam Live (VF0050). The camera has the following noteworthy specifications:

- 640×480 (VGA) CMOS sensor
- Video capture at up to 30 fps
- Still image captures at up to 1024×768 resolution
- USB connection

The camera will be connected to the development board via a standard USB connection. And the power for the camera is supply by the USB 5V dc connection.

General Design

Due to no physical enclosure being used for the camera, it will be recommended that the user places the camera in a place where the pet cannot compromise its functionality.

9. System Test Plan

The Pet Care System will undergo a rigorous testing procedure. All five individual components will undergo a unique test that will verify if the functional requirements have been satisfied. Following the verification of the individual components performance, the entire system will be tested. Although a thorough test plan has not been created, the subsequent paragraphs give an overview of the testing.

Each component will be tested with a sole connection to the development board. The functionality of each component will be verified by manually controlling the component and forcing the component to perform its respective functions.

Due to reliance on the respected power supplies, the individual components' power supply will be tested to ensure that is sufficient to perform normal operations. Subsequent tests will examine the power supply's performance when all individual components are operating simultaneously. With all individual components moving, the power drawn will be measured and compared with the rating of the power supply. After the parts have been moving continuously in excess of 2 minutes, visual inspections will be performed to confirm the system's operation and to verify that the operating temperature of the various components are within safe limits.

Following normal operation tests, the component will be put in a compromised scenario and error conditions will be simulated and the system response verified.

Following the tests in the laboratory, typical usage scenarios will be developed and performed with real animals. A typical normal operation scenario, featuring a pet dog, is given below:

1. Press webpage button to use speaker to call dog over to food dispenser
2. Feed dog by pressing the webpage button to control food dispenser
3. Press webpage button to unlock gate
4. Press webpage button to lock gate
5. Press webpage button to show the real time video from the video camera

As in the laboratory, additional usage scenarios will verify the operational safety and error handling.

10. Conclusion

The design specifications give a detailed report of the design that the Pet Care System will embody. With this design, the capabilities and requirements of the Pet Care System will be met. The prototype that will be delivered on April 17, 2009 will follow these designs and will focus on the market of owners with dogs and cats. Following the acceptance of this document, Pioneer Solutions will begin the production of the prototype.

11. References

[1] Pioneer Solutions, “Pet Care System Functional Specifications”, Simon Fraser University, Burnaby, BC, Canada, February 2009.

[2] Wikipedia, *Wikipedia entry for “stepper motor”*, 2009. [Online]. Available: http://en.wikipedia.org/wiki/Stepper_motor. [Accessed: February 28, 2009].

[3] Wikipedia, *Wikipedia entry for “H-Bridge”*, 2009. [Online]. Available: http://en.wikipedia.org/wiki/H-bridge. [Accessed: February 28, 2009].

[4] IHS, *IEC 60228 Conductors of Insulated Cables*, 2004. [Online]. Available: http://electronics.ihs.com/document/abstract/UNJOGBAAAAAAAAAA. [Accessed: February 28, 2009].

[5] UC Dragon, *Development Board Home Page*, 2009. [Online]. Available: http://www.ucdragon.com [Accessed: March 1, 2009].

[6] comScore, *Light PC Internet Users Are 30 Percent More Likely than Heavy PC Internet Users to Access Mobile Internet Content*, 2009. [Online]. Available: http://www.comscore.com/press/release.asp?press=2739. [Accessed: March 4th, 2009].

[7] Wikipedia, *Wikipedia entry for “Server”*, 2009. [Online]. Available: http://en.wikipedia.org/wiki/Server_(computing). [Accessed: March 2, 2009].

[8] D. Clark and M. Owings, “Motor Control 101, The Basics,” in Building Robot Drive Trains, The New York: McGraw-Hill Companies, Inc, 2003, pp. 218-220.

[9] Wikipedia, *Wikipedia entry for “Application Programming Interface”*, 2009. [Online]. Available: http://en.wikipedia.org/wiki/API. [Accessed: March 5, 2009].