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RE: Functional Specification for an automatic cat feeder

Dear Lucky,

The attached document is Nekotek's Functional Specification for an Automatic Cat Feeder, MEO.

Our project is to develop an automatic feeding device, MEO, that helps cat owners alleviate some of the daily feeding chores involved in owning a cat. MEO will give cat owners the ability to feed their cats even if they are not home. MEO has a telephone, keypad and LCD user interface for easy access of functions.

The functional specifications list the requirements of the MEO for the deadline in April 2nd. MEO is composed of five modules: controller, telephone interface, dispenser, base and container. For each module, the functional specifications are categorized to encompass the system, interface and physical requirements.

Nekotek consists of five creative and talented engineering students: Benjamin Wang, Jason Chang, Eric Huang, Leung Hoang and Christian Losari. If you have any questions or concerns, please contact us by sending an e-mail to ensc440-nekotek@sfu.ca

Sincerely,

Benjamin Wang

Benjamin Wang
Chief Executive Officer
Nekotek

Enclosure: Functional Specification for an automatic cat feeder

Abstract

MEO is an automatic cat-feeding device. The device can be set to automatically feed cats with a specified amount of food at preset times. Cat owners can also operate the MEO system remotely via telephone calls. The MEO system also has the ability to monitor and record a cat's feeding habits, such as feeding time and the amount of food consumed.

The functional specification document will outline the functionality and requirement of the proposed MEO system. The MEO system consists of the following modules:

- 1) Controller module
- 2) Telephone Interface module
- 3) Container module
- 4) Dispenser module
- 5) Base module

The Controller module is the brain of the MEO system and communicates with the other modules. The Controller decides the actions of each module based on the information it receives from user inputs and module feedback. The Telephone Interface module receives phone calls and determines whether or not to inform the Controller module about the possible action of activating the feeder machine. The Container module acts as the storage facility for the dry cat food and has the ability to detect low amounts of cat food. The Dispenser module receives instructions from the Controller module to initiate transferal of food from the Container to the Base module. The Base module consists of the bowl that the cat eats from and a sensing device that tells how much food is left in the bowl. The leftover food information is fed back to the controller.

The document will specify the system requirements, interface requirements and physical requirements. System requirements describe the functionality of the module; physical requirements describe the dimension and operating conditions; interface requirements describe the data communication between users and other modules.



Functional Specification for Automatic Feeder System

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Table of Contents

| | |
|-------------------------------|----|
| Abstract | ii |
| Title Page | 1 |
| Table of Contents | 2 |
| List of Figures | 4 |
| List of Tables | 4 |
| 1. Glossary | 5 |
| 1.1. Acronyms | 5 |
| 1.2. Definitions | 5 |
| 2. Introduction | 6 |
| 2.1. Scope | 6 |
| 2.2. Intended Audience | 6 |
| 2.3. Document Conventions | 6 |
| 3. System Overview | 7 |
| 3.1. Overall Requirements | 7 |
| 3.2. System Limitations | 8 |
| 4. System Modules | 9 |
| 4.1. Controller | 9 |
| 4.1.1. System requirements | 9 |
| 4.1.2. Interface requirements | 10 |
| 4.1.3. Physical Requirements | 11 |
| 4.2. Telephone Interface | 11 |
| 4.2.1. System Requirements | 11 |
| 4.2.2. Interface Requirements | 12 |
| 4.2.3. Physical Requirements | 12 |
| 4.3. Container | 12 |
| 4.3.1. System Requirements | 13 |
| 4.3.2. Interface Requirements | 13 |
| 4.3.3. Physical Requirements | 14 |
| 4.4. Dispenser | 14 |
| 4.4.1. System Requirements | 15 |
| 4.4.2. Interface Requirements | 15 |
| 4.4.3. Physical Requirements | 15 |
| 4.5. Base | 16 |
| 4.5.1. System Requirements | 16 |
| 4.5.2. Interface Requirements | 16 |

| | |
|------------------------------------|----|
| 4.5.3. Physical Requirements | 17 |
| 5. Documentation and User Training | 18 |
| 6. Conclusion | 19 |

List of Figures

| | |
|--|----|
| Figure 1: Legend for diagrams | 6 |
| Figure 2: System Overview Block Diagram | 7 |
| Figure 3: Overview of Controller Module | 9 |
| Figure 4: Overview of Telephone Interface Module | 11 |
| Figure 5: Overview of Container Module | 13 |
| Figure 6: Overview of Dispenser Module | 14 |
| Figure 7: Overview of Base Module | 16 |

List of Tables

| | |
|---------------------|----|
| Table 1: DTMF Tones | 12 |
|---------------------|----|

1. Glossary

1.1. Acronyms

| | |
|------|--------------------------------------|
| DTMF | Dual Tone Multi Frequency |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MCU | Microcontroller Unit |
| MEO | Product name of Automatic Cat Feeder |
| RJ11 | Registered Jack function 11 |

1.2. Definitions

| | |
|-----------------|---|
| DTMF | A method used by the telephone system to communicate the keys pressed when dialing. |
| Microcontroller | A single integrated circuit intended to operated as an embedded system |
| RJ11 | North American style telephone jack with 6 possible wire connections. |
| Sensor | A device that receives and responds to a signal or stimulus |

2. Introduction

The MEO system is an automatic feeding device that can be set to feed cats at predetermined time and amount, and can be operated remotely with telephone calls. The MEO system can be viewed as 5 modules. While the controller module acts as the brain of the system, each of the other modules has its own function and communicates with the controller module in order to complete the required tasks.

2.1. Scope

This Functional Specification document for MEO lists the requirements of the automatic cat feeder. This document will encompass the system, interface and physical requirements for the different modules of the MEO system.

2.2. Intended Audience

This functional specification document is intended mainly for the design engineer team of Nekotek. This document will serve as the blueprint and guideline during the development phase of the project. Nekotek will also use this document as a management tool so that the progress of the project can be quantified in terms of the requirements that are met. This document may also be presented to potential investors as a technical explanation of the project.

2.3. Document Conventions

We will use the following notation for the requirement list for each module in this document.

[R ##] Requirement description

[L ##] System limitation description

[D ##] Documentation requirement description

The ## sign is the item numbers for the corresponding categories.

The arrows in the block diagrams follow the legend shown in Figure 1 below.



Figure 1: Legend for diagrams

3. System Overview

The MEO system overview is shown Figure 2 below.

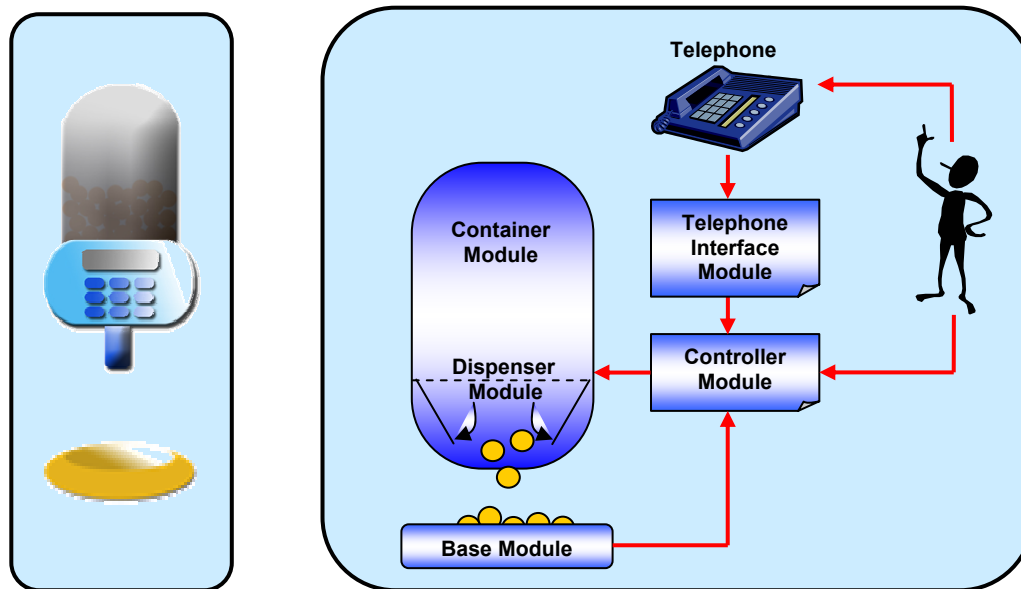


Figure 2: System Overview Block Diagram

The MEO system consists of five modules: Controller, Telephone Interface, Dispenser, Container and Base. The user interacts with the MEO directly through the Controller module or indirectly via a telephone call through the Telephone Interface module. The Controller module receives real time signals from other system modules, processes the signals and sends appropriate control signals to relevant modules for actions such as dispensing food and displaying information on the LCD.

3.1. Overall Requirements

The following lists the overall requirements for the MEO automatic cat feeder which encompass operating conditions, life-span and safety requirements.

- [R1] System must be powered using a standard 110V 60Hz AC outlet.
- [R2] System must operate from 0°C to 60°C.
- [R3] Power cords will be insulated using non-chewable material.

- [R4] System dimensions will be approximately than 30cm × 40cm × 50cm (Length × Width × Height).
- [R5] The weight of an empty feeder system will not exceed 3 kilograms.
- [R6] System can be secured to a wall or floor.
- [R7] Reliable operation of the system will be guaranteed for 1 year.
- [R8] Dry cat food can be stored in the container for 5 weeks before spoilage.
- [R9] Safety measures will be implemented to ensure that unauthorized personnel or animal do not trigger feeding.
- [R10] Electronic components must not be accessible by unauthorized personnel.

3.2. System Limitations

- [L1] The user must use a dial tone base phone to interact remotely with the system.
- [L2] The system is not designed for wet cat food.
- [L3] The system is designed for a single cat use only.
- [L4] The size of the cat food pellet is limited to 1 cm in diameter.

4. System Modules

4.1. Controller

The Controller module consists of a MCU, LCD display and a keypad. The main function of the Controller module is to provide means for processing signals from other modules and receiving user inputs. Figure 3 shows the block diagram of the controller module.

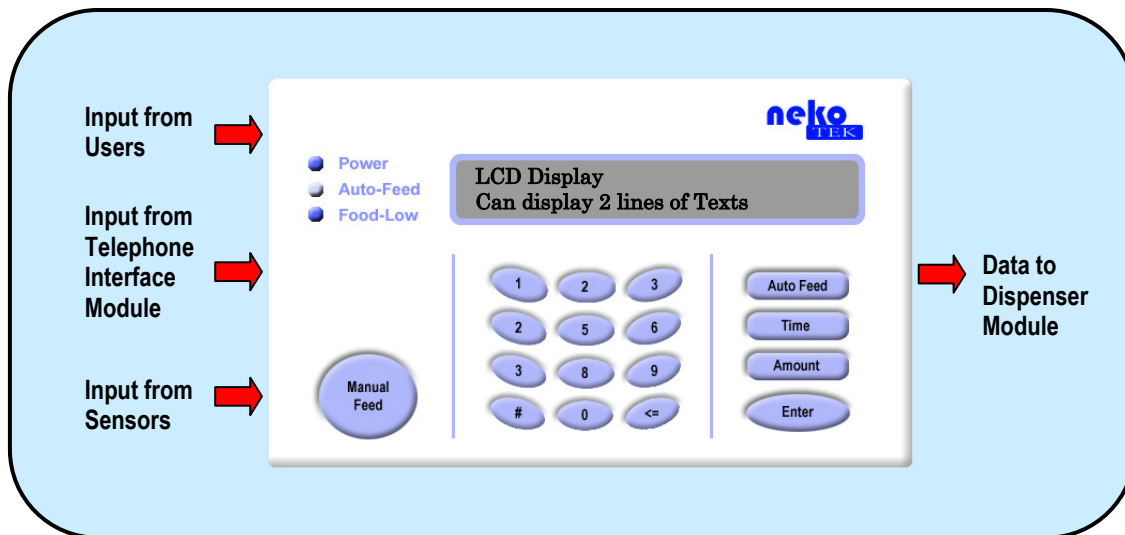


Figure 3: Overview of Controller Module

4.1.1. System requirements

- [R11] The module must have a clock running to keep track of the time of day.
- [R12] The module must activate the food dispenser upon user request through telephone, manual feed button or at the preset time.
- [R13] The module will display on the LCD the feeding time and the amount of food to be dispensed.
- [R14] The module will receive configuration input through the buttons on the keypad.
- [R15] The module must receive signals from sensors notifying the level of food in the food storage unit and the amount of food in the bowl.
- [R16] The module will automatically update the preset time to feed the cat based on the times when manual feed is initiated.

- [R17] The module will compute the average of the manual feed times over a period of 5 days and use the average time for automatic feeding. The computed average feeding time is accurate to 2 minutes.
- [R18] The module will compute the average feeding amount over a period of 5 days. The computed average feeding amount is accurate to 1 g.
- [R19] The total amount of food in the bowl after automatic dispensing must be the prescribed amount $\pm 5\text{g}$ by the user. The module computes the appropriate amount of food to be dispensed based on the leftover food in the bowl during automatic feeding.

4.1.2. Interface requirements

- [R20] An LED must be used to indicate the power is on.
- [R21] The module must have an “Auto-Feed” LED indicating the status of auto-feed feature.
- [R22] The module must have a button to turn on and off the auto-feed feature. The auto feed feature can be turned on with this “Auto Feed” button or by the signals received from the Telephone Interface module.
- [R23] The Controller module must receive signals from the Telephone Interface module and based on the signal received from the Base module, the Dispenser module is instructed to initiate feeding.
- [R24] The module will have a “Time” button to set the auto feeding time. The steps required to set the feeding time is as follows:
 1. Press “Time” button.
 2. The LCD will prompt the user to enter hours and minutes.
 3. Enter the number for hours and minutes using the keypad. Mistake can be corrected by pressing the backspace arrow button.
 4. Press “Enter” when done.
- [R25] The module will have an “Amount” button to set the amount of the food to be dispensed. The steps required to set the feeding amount is as follows:
 1. Press “Amount” button.
 2. The LCD will prompt the user to enter the amount of food in grams.
 3. Enter the number of grams using keypad. Mistakes can be corrected by pressing the backspace arrow button.
 4. Press “Enter” when done.
- [R26] The keypad on the module will allow user to input numbers when prompted by the LCD display.

[R27] The module must have a “Manual Feed” button to override all auto-feed features and dispense food immediately. The amount of food dispensed immediately is proportional to the length of time the user presses on the Manual Feed button.

[R28] The module must have a “Food-Low” LED warning to indicate that the food level in the container is low. More food should be added to the container when this LED is on.

4.1.3. Physical Requirements

[R29] The Controller module must be operated through a 5VDC AC adapter.

[R30] The Controller module must be mounted together with other modules with the LCD display and keypad visible and easy for access.

4.2. Telephone Interface

The Telephone Interface module consists of circuitry to pick up incoming phone calls and to determine if the phone call is for activating MEO. This module will be able to decode DTMF tones that represent the number sequence sent by the caller and send appropriate signals to the Controller module. If the incoming phone calls are the usual voice phone call, the Telephone Interface module will ignore it. Figure 4 shows the block diagram for the Telephone Interface module.

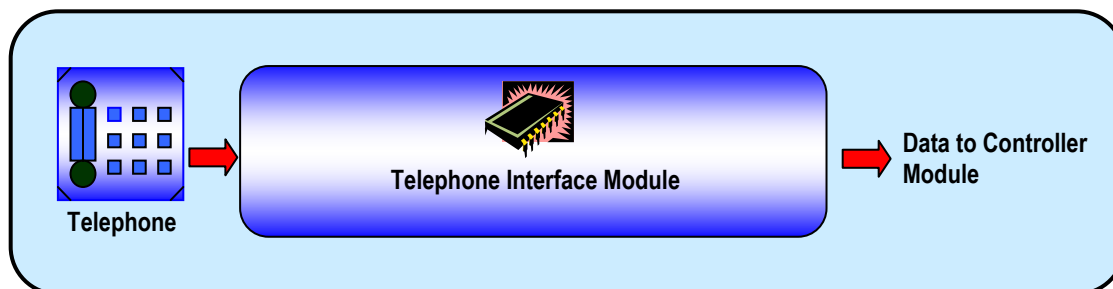


Figure 4: Overview of Telephone Interface Module

4.2.1. System Requirements

[R31] The module must be compatible with the standard RJ11 telephone jack.

[R32] The module must pick up phone calls after a user programmable number of rings.

[R33] The module must be able to decode the telephone DTMF tones and send appropriate action signals to the Controller module. Table 1 shows the DTMF tones generated by touchtone phones.

Table 1: DTMF Tones

| Key | Frequency (Hz) | Frequency (Hz) |
|-----|----------------|----------------|
| 1 | 697 | 1209 |
| 2 | 697 | 1336 |
| 3 | 697 | 1477 |
| 4 | 770 | 1209 |
| 5 | 770 | 1336 |
| 6 | 770 | 1477 |
| 7 | 852 | 1209 |
| 8 | 852 | 1336 |
| 9 | 852 | 1477 |
| * | 941 | 1209 |
| 0 | 941 | 1336 |
| # | 941 | 1477 |

4.2.2. Interface Requirements

[R34] The user must be able to use a standard 3×4 keypad to send DTMF tones to the module through a telephone call

[R35] The module will send feedback tones to the calling user.

4.2.3. Physical Requirements

[R36] The module circuitry will take up an area of 5×5 cm²

[R37] The module circuitry will be lightweight and will be less than 50 g.

[R38] The Telephone Interface module is resistant to electrostatic discharge.

4.3. Container

The Container module of the MEO system is comprised of a cylindrical/funnel-shaped food storage unit and capacity-sensing logic. Figure 5 below shows a block diagram of the Container module.

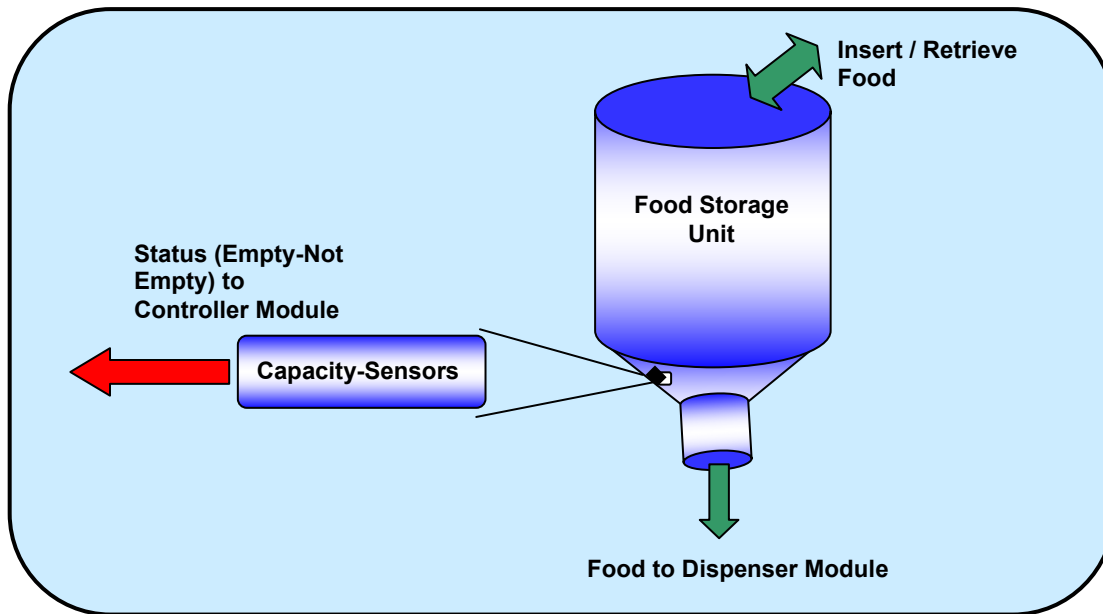


Figure 5: Overview of Container Module

4.3.1. System Requirements

- [R39] The level-sensing circuitry must be powered using the same power utilized by the Controller module.
- [R40] The level-sensing circuit must send the status information to the Controller module when food levels are 95% depleted.
- [R41] Food must be transferred from the Container through the Dispenser module and into the Base module.

4.3.2. Interface Requirements

- [R42] The food storage unit must include a lid that users can open and close.
- [R43] Food must be deposited or retrieved from food storage unit from the opening presented when the lid is opened.
- [R44] Food storage unit will be easily detachable from capacity-sensing logic as well as overall unit to allow users to wash the food storage unit without damaging other elements of the MEO system.

4.3.3. Physical Requirements

[R45] The food storage unit is able to store one 2-kg bag of dry cat food.

Note: The above requirement is modeled after a bag of Iams Original Formula Cat food and recommended servings for a 2-year-old adult cat for purposes of weight maintenance. One 4-pound bag of Iams Original Formula Cat Food will last for 5 weeks if a daily serving of 1¼ Ounces or ½ Cup is supplied.

[R46] An air-tight lid must be incorporated as part of the container element to minimize food spoilage.

[R47] The Container module will be characterized by a funnel-shape near the lower ¼ of the food storage unit to minimized residue food.

[R48] Food storage unit will weigh less than 0.5 kg.

[R49] The food storage unit must be manufactured using plastic materials to allow for ease of maintenance.

[R50] Recommended cleaning intervals of food storage unit is 2 weeks.

4.4. Dispenser

The Dispenser module receives instructions from the Controller module to transfer cat food from the container to the bowl. Figure 2 shows the Dispenser module with respect to other modules of MEO.

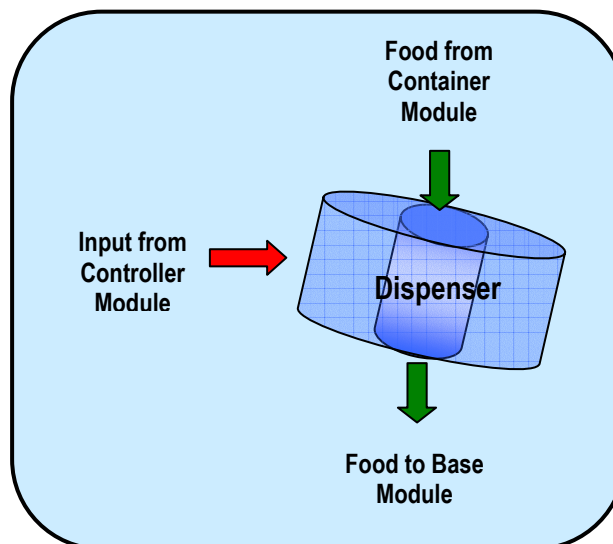


Figure 6: Overview of Dispenser Module

4.4.1. System Requirements

- [R51] The module must be capable of transferring average sized dry cat food.
- [R52] The module must not affect the quality and condition of the cat food.
- [R53] The module must not harm the cat or people.

4.4.2. Interface Requirements

- [R54] The module must receive instructions from the Controller module to operate.
- [R55] The module must dispense the amount of cat food prescribed by the Controller with an accuracy of ± 5 grams.
- [R56] The module must transfer the prescribed amount of cat food within 30 seconds.

4.4.3. Physical Requirements

- [R57] The module must be a physical barrier between the food in the container and the bowl.
- [R58] The weight of the module shall not exceed 1 kg.
- [R59] The dimensions of the dispenser shall be approximately 15cm x 15cm x 15cm.

4.5. Base

Figure 7 below shows the block diagram for the Base module. The bowl is used to hold the dispensed cat food. The base consists of a weight sensor that will be used for detecting the amount of food in the bowl.

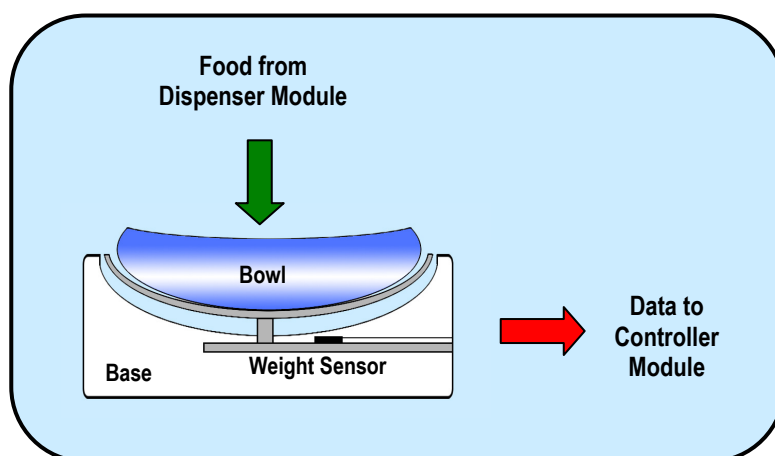


Figure 7: Overview of Base Module

4.5.1. System Requirements

- [R60] The circuitry for the weight sensor must be powered up using the same power supply as the Controller module.
- [R61] The weight sensor must not send any data to the Controller module if the “manual feed” button is pressed.
- [R62] The module must have weighing accuracy of $\pm 5\text{g}$.

4.5.2. Interface Requirements

- [R63] The weight sensor must send data to the Controller module informing the amount of food in the bowl.
- [R64] The bowl will be allowed to be lifted up from its base for cleaning purposes.

4.5.3. Physical Requirements

[R65] The bowl will be made of plastic and it weigh less than 200 g.

[R66] The amount of food dispensed can be reconfigured by the users. The bowl is only able to store up to a maximum of 100 g of cat food unless “manual feed” button is pressed.

[R67] The base is made of plastic.

[R68] The bowl and its base will weigh no more than 0.5 kg.

5. Documentation and User Training

The operation and user interface of the automatic cat feeder, MEO, will be implemented to be user friendly. With a user-oriented design approach, user training should be minimal to achieve fluent use of the device. Alongside the market-ready version of this product, a printed user manual will be included.

- [D1] Basic instruction will be written in English and French in the user manual.
- [D2] The intended audience of the manual must focus on users with minimal technical knowledge.
- [D3] Extensive usage of diagrams must be used to aid in instructing the user on the operation of the device.
- [D4] The manual must cover configuration, start-up and operation of the device.
- [D5] The manual will provide information on recommended maintenance intervals and cat diets.
- [D6] Copyright and warranty information will be included.
- [D7] Contact information will be included.

In addition, technical assistance will be provided as an online website.

- [D8] Website must be written in English.
- [D9] The user manual must be downloadable from the website.
- [D10] Website must be troubleshooting based.

6. Conclusion

The requirements specified in this document characterize the minimal functionality of the final product for the MEO automatic cat feeder system. Nekotek will use the specified requirements as a blueprint for the design specification document. By striving to meet the functional specifications, Nekotek will ensure a solid foundation for future improvements and innovations. Nekotek will incorporate all of the appropriate requirements in creating a prototype by the April, 2003 deadline.