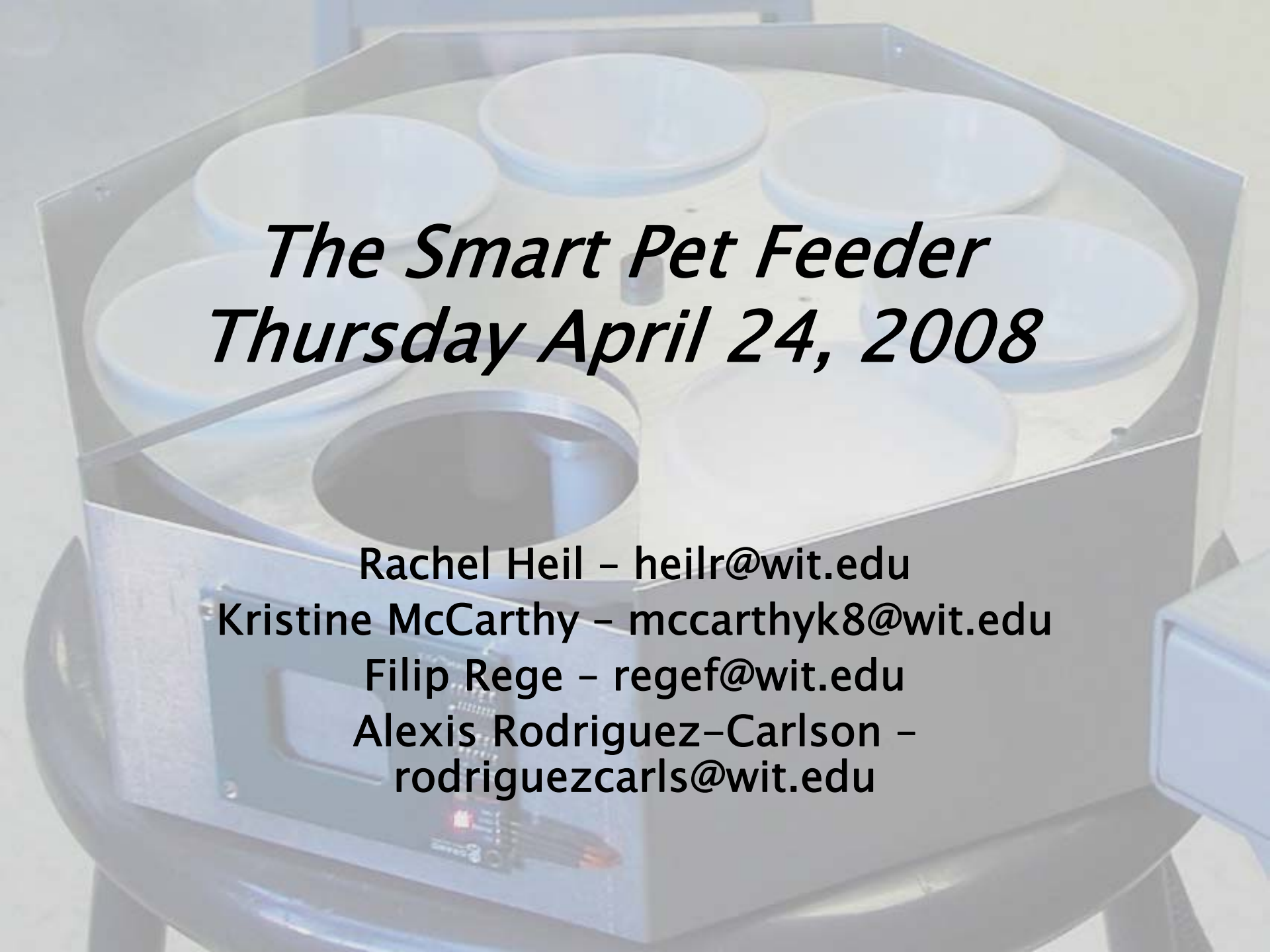

The Smart Pet Feeder
Thursday April 24, 2008

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Introduction

- Market Research:
  - $41 billion spent in the pet care industry in 2007 ("Industry Statistics & Trends". American Pet Products Manufacturers Association, Inc.)
  - 63% of US households include a pet as of 2007 ("Industry Statistics & Trends". American Pet Products Manufacturers Association, Inc.)
  - After consumer electronics, pet care is the fastest growing industry in the US ("The Pet Economy". Business Week.)
  - 40% of American pets are overweight ("The Overweight Pet." ThePetCenter.Com.)

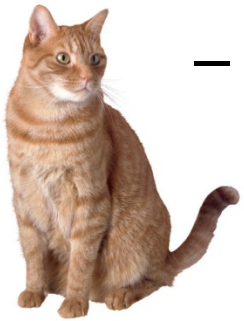
Introduction

- Problems that pet owners face:
  - Portion control
  - Weight management
  - Feeding on a set schedule

The ERGO 8 day feeder

Objectives

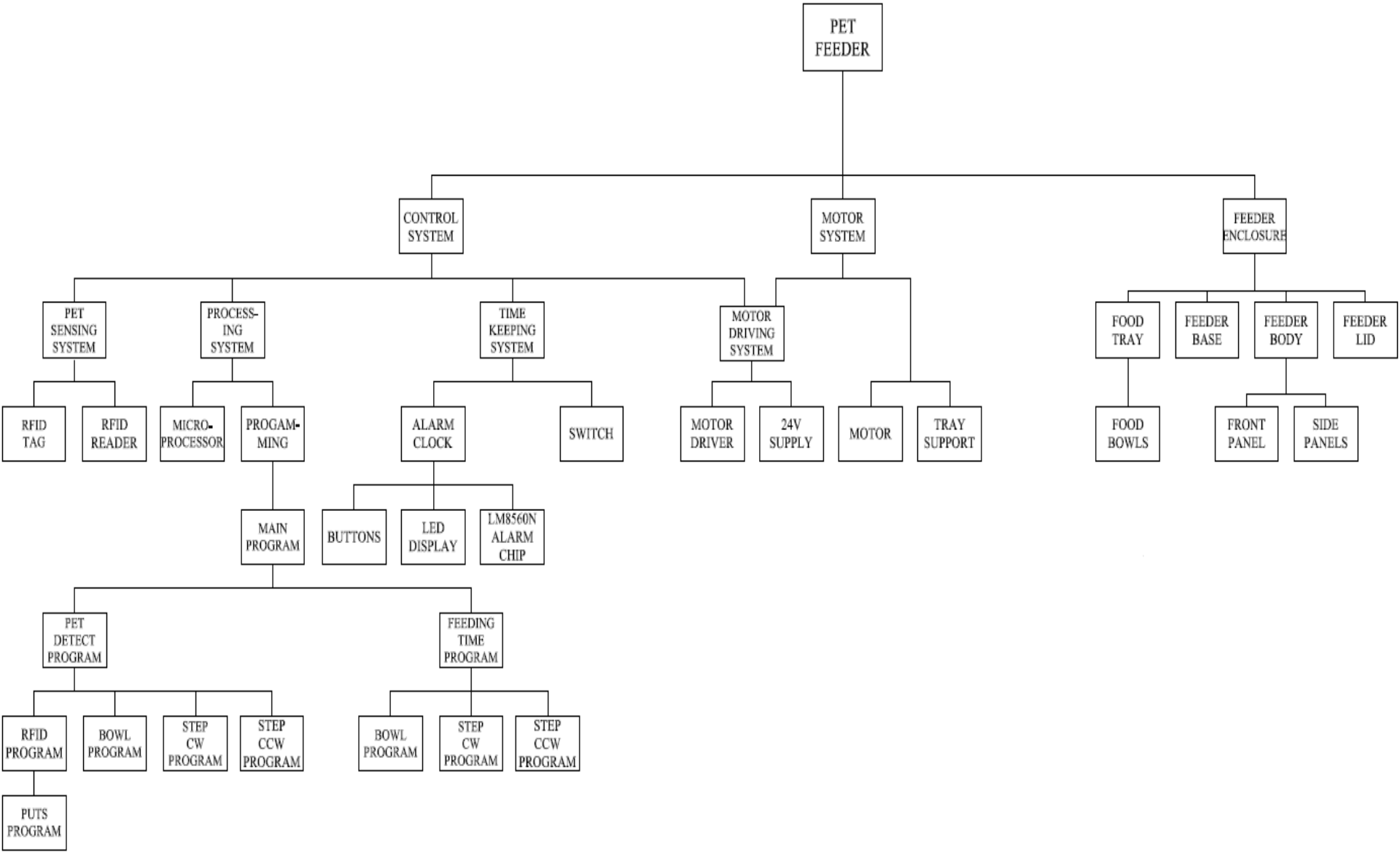
- Complaints to be addressed by The Smart Pet Feeder
  - Pets flip over the feeder
  - Flimsy construction
  - Feeder turns too slowly
  - Unreliable feeding
  - Difficult to program
  - Cover rotates
  - Battery life
  - No control over access



The Smart Pet Feeder

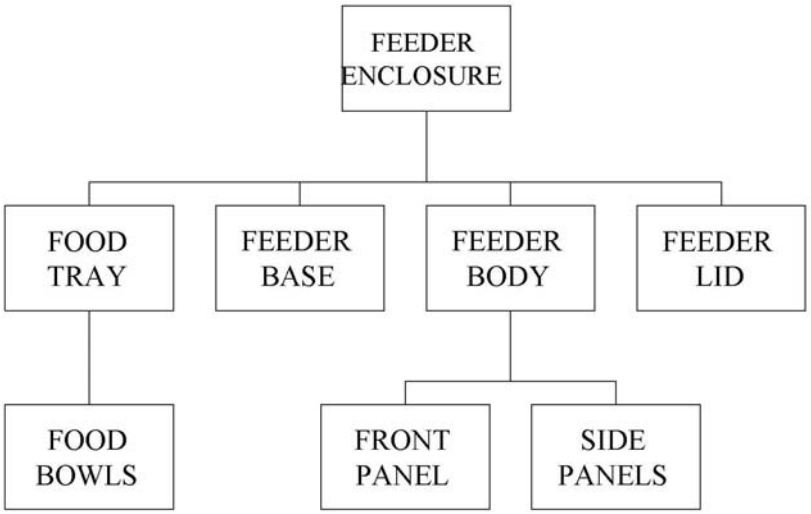
- What will it do?
  - Enable a pet owner to feed their pets at specific time of day without being physically present at feeding time
  - Allow a pet owner to feed a number of different pets different types of food without the possibility of one pet eating another pet's food

Overall Design



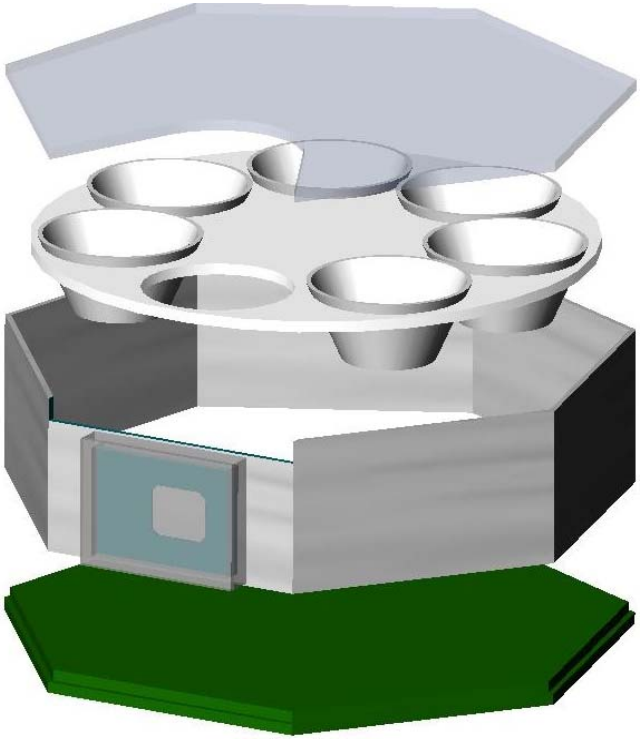
Feeder Enclosure

- Requirements
  - Sturdy construction
  - Restrict pets from accessing food for later feedings
  - Allow user to view later feedings

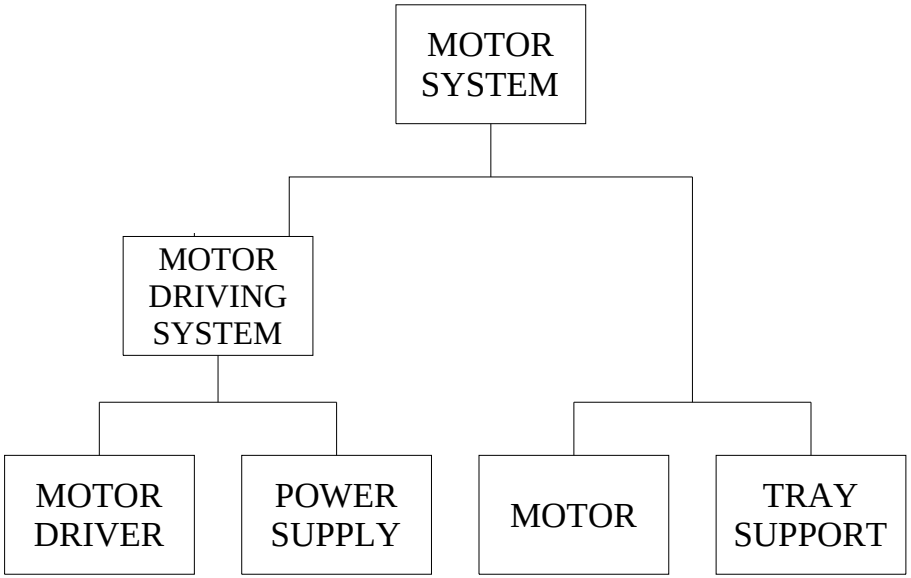


Feeder Enclosure

- How we chose the shape
  - Seven flat sides are easy to make
- How we chose the materials



Motor System



Motor System

- Requirements
  - Turn the tray with the combined weight of the cups and food
  - Be able to turn one cup forward as well as backward
  - Interface with the microcontroller easily
  - Isolate the load from the shaft of the motor

Motor System

Direct Drive

Project name: **Auto Pet Feeder**

What is the shape of the load?

- ○ Thin Plate
- ◉ Thin Circular Disk
- ○ Cylinder
- ○ Slender Rod
- ○ Spehere
- ○ Thin Ring
- ○ Cone
- ○ Hemisphere

Disk Radius: 6 Inches

Top Speed: 1 RPS

Weight of the Load: 2 Lbs

Acceptable time to accelerate to top speed: 0.5 Seconds

Axis of Rotation: ○ X ○ Y ◉ Z

Rotational offset from center of gravity: 0 Inches

Maximum Available Current: 4.5 Amps

Maximum Available Voltage: 24 Volts (DC)

BACK | SUBMIT | RESET

1 ENTER DATA » 2 SELECT MOTOR » 3 VIEW GRAPH » REQUEST QUOTE

Please select a model. For detailed specifications, please click on the motor model or image.

* Torque values are reported as Holding Torque in units of oz-in (more)

On average dynamic torque is approximately **70%** of holding torque.

The required dynamic torque for your application is 18.75 oz-in

1.8 Degree Motors

NEMA 11	Torque*
211-13	9.2
211-18	13.7
211-20	16.6

NEMA 14	Torque*
3518Y	7.5

NEMA 17	Torque*
4118S	45.0
4118M	63.0
4118L	83.0

NEMA 23	Torque*
5718X	100
5718M	173
5718L	294

NEMA 34	Torque*
8718S	424
8718M	851
8718L	1288

0.9 Degree Motors

NEMA 14	Torque*
3609Z	4.0
3609Y	16.0

NEMA 17	Torque*
417-11	17.5
417-13	28.0
417-15	32.0

4209S	35.2
4209M	55.44
4209L	70.0

4109Z	3.0
4109Y	6.0
4109X	7.0
4109V	15.0
4109R	22.0

4116-05	6.0
4116-06	7.0
4116-07	8.0

NEMA 23	Torque*
5709X	92
5709M	170
5709L	260

0.45 Degree Motors

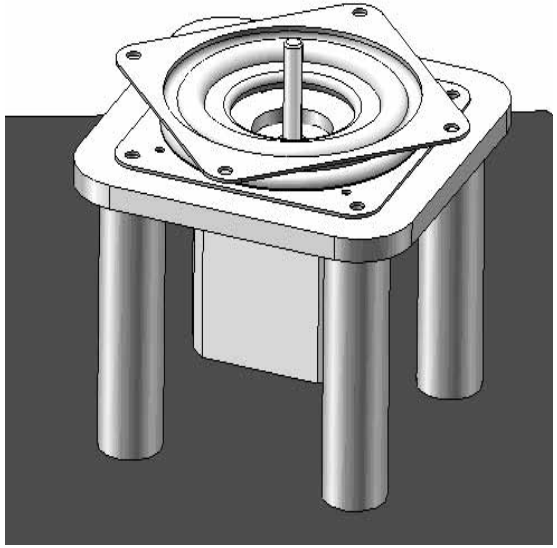
NEMA 23	Torque*
5704X	75
5704M	140

Motors shaded out do not meet your calculated torque requirements. However, they can still be selected. Please consider using a gearbox if applicable.

BACK | NEXT

Motor System

- Tray support system
  - Requirements
    - Support the weight of the tray and food
    - Allow tray to rotate smoothly
  - Components
    - Aluminum plate
    - Turntable
    - Delrin legs



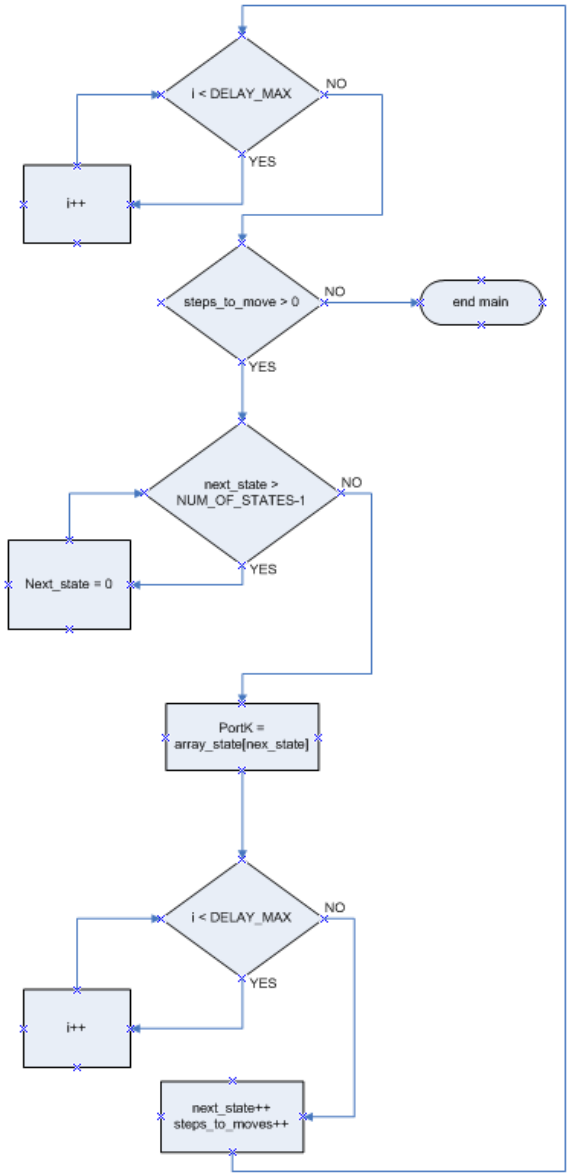
Motor System

- Driver Chip
  - Supplies current to motor that the microcontroller is unable to supply
  - Protects the microcontroller from the high current of the motor

Motor System

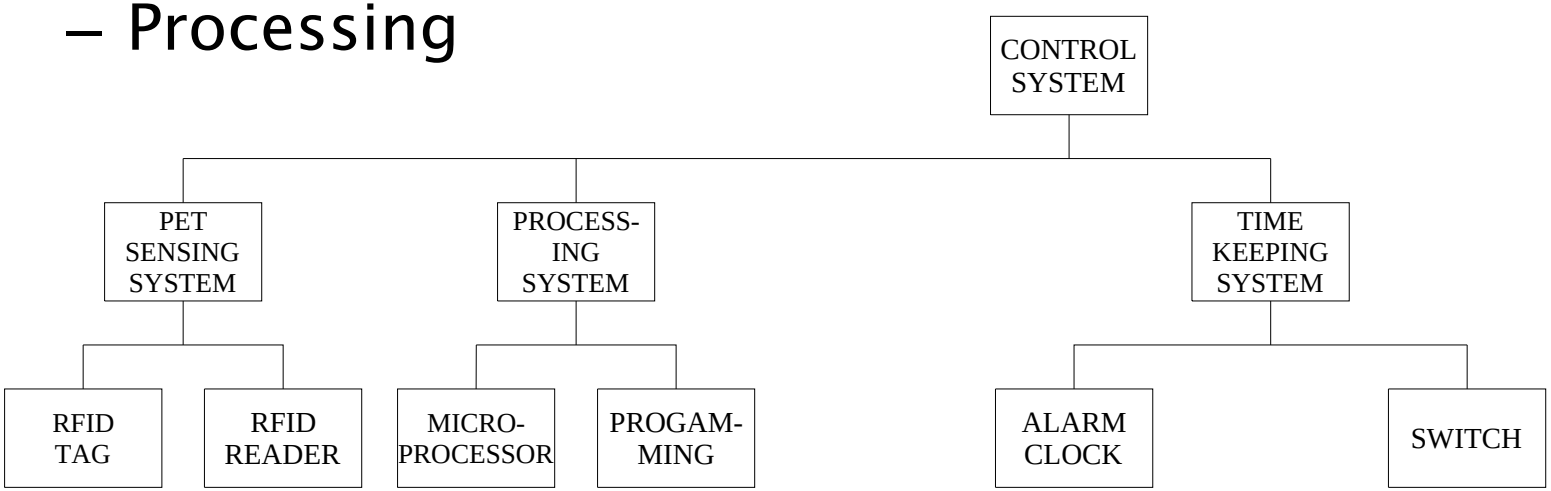
- Programs
  - Clockwise rotation
    - Reveals a new bowl of food at the user programmed time
  - Counterclockwise rotation
    - Rotates the bowl back to an empty position when the RFID reader senses the forbidden pet

Motor System



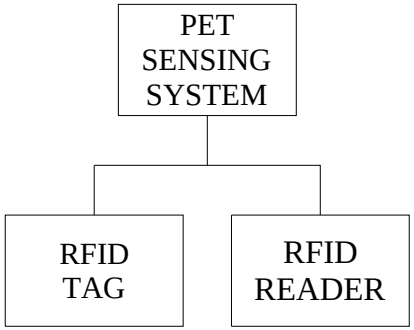
Control System

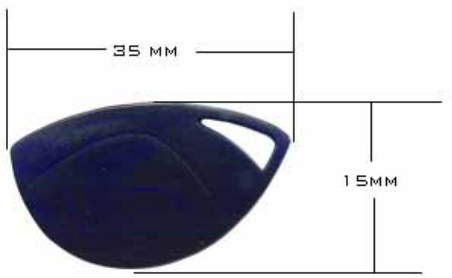
- Three main subsystems
  - Pet Sensing
  - Time Keeping/Display
  - Processing

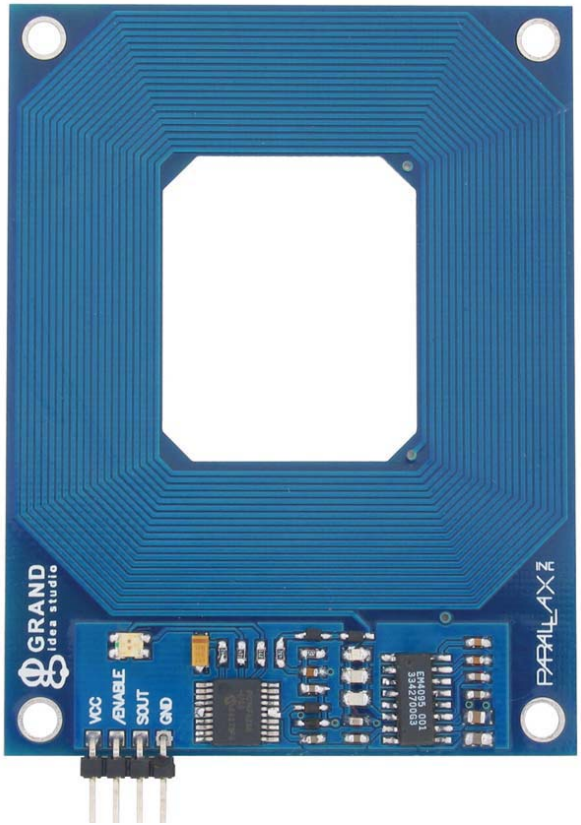


Pet Sensing System

- Consists of an RFID reader and an RFID tag







Pet Sensing System

- Requirements
  - Recognize forbidden pets
  - Be able to tell the microcontroller that the pet is there
  - Work quickly enough to allow minimal food consumption

Pet Sensing System

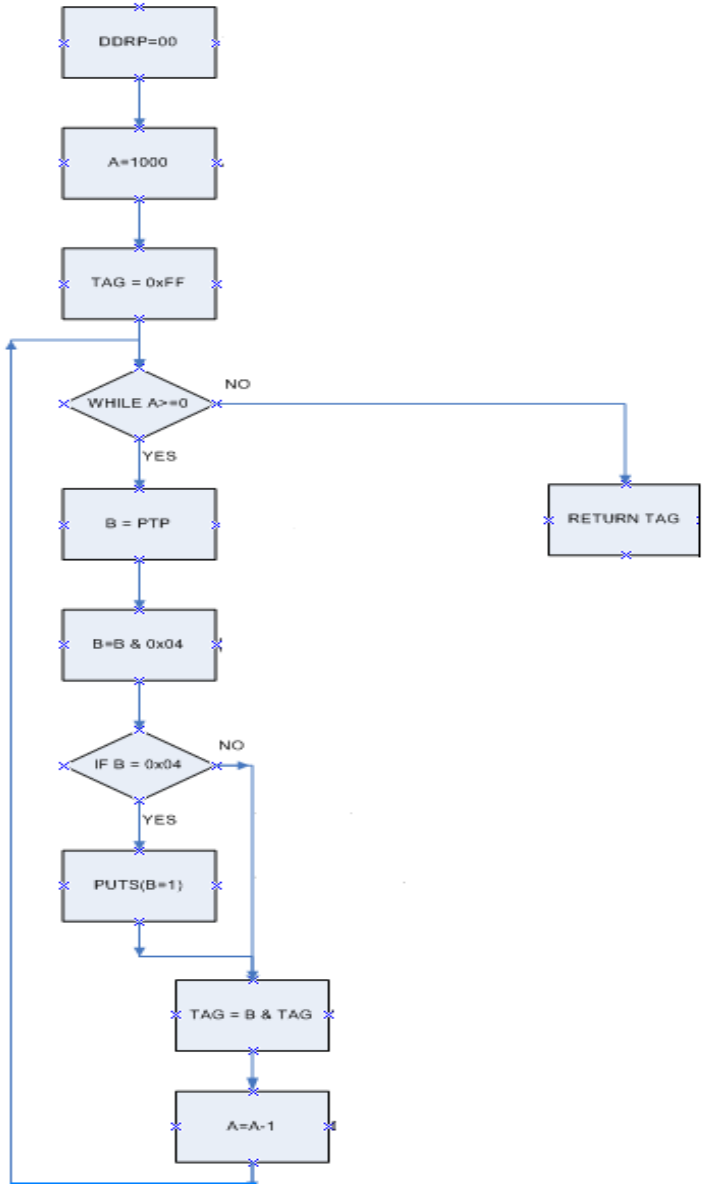
- Health Concerns
  - Cancer in lab rats
    - Only tested with implantable chips
  - Many say this would happen with other animals
    - FDA approved for human implantation
    - Some veterinarians believe that the small size of the animals makes them more susceptible than larger animals
  - Tag can be sheilded to alleviate these converns

Pet Sensing System

- PROGRAM
  - Tells the microcontroller that the forbidden pet is present
    - Tells the motor that it must turn
    - After the pet has moved away, no longer senses the tag and tells the motor it is OK to rotate back

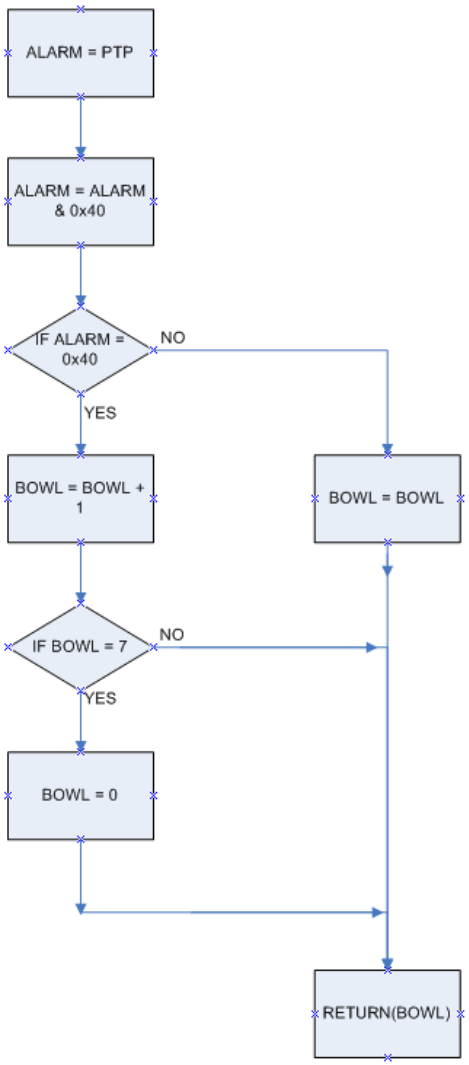
Pet Sensing System

RFID Program



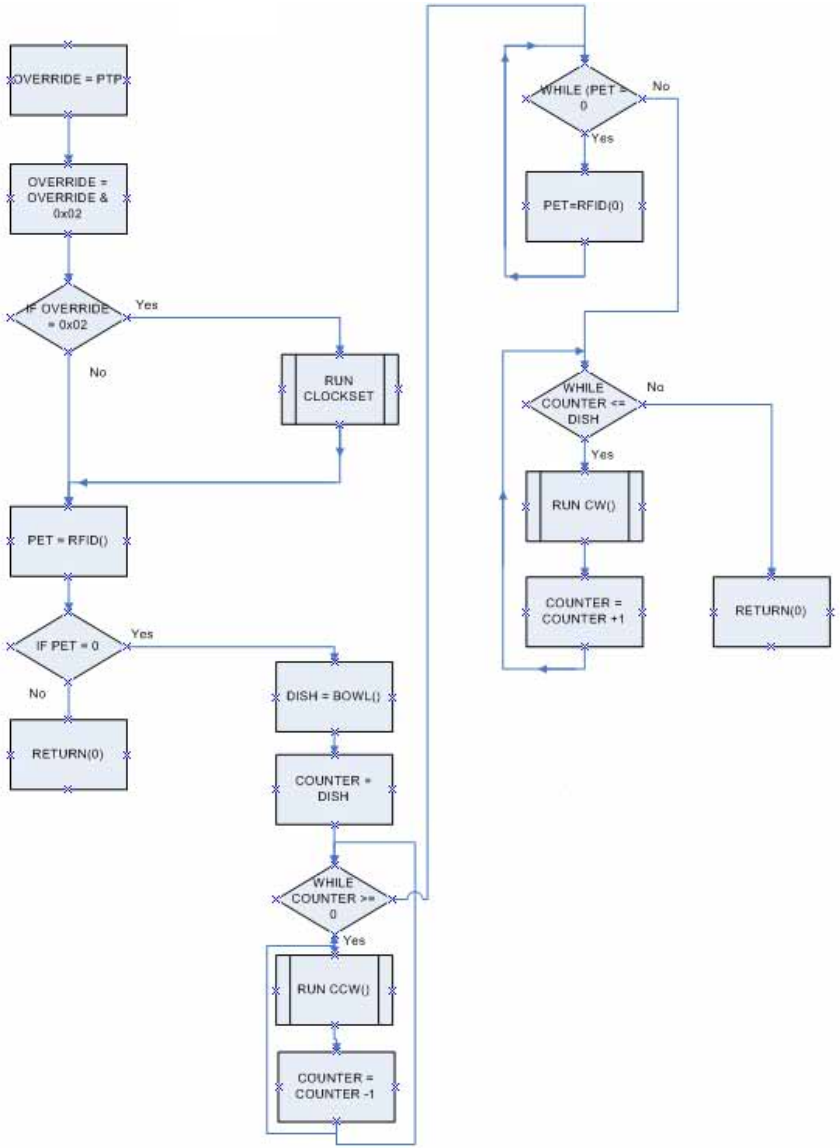
Pet Sensing System

Bowl Program

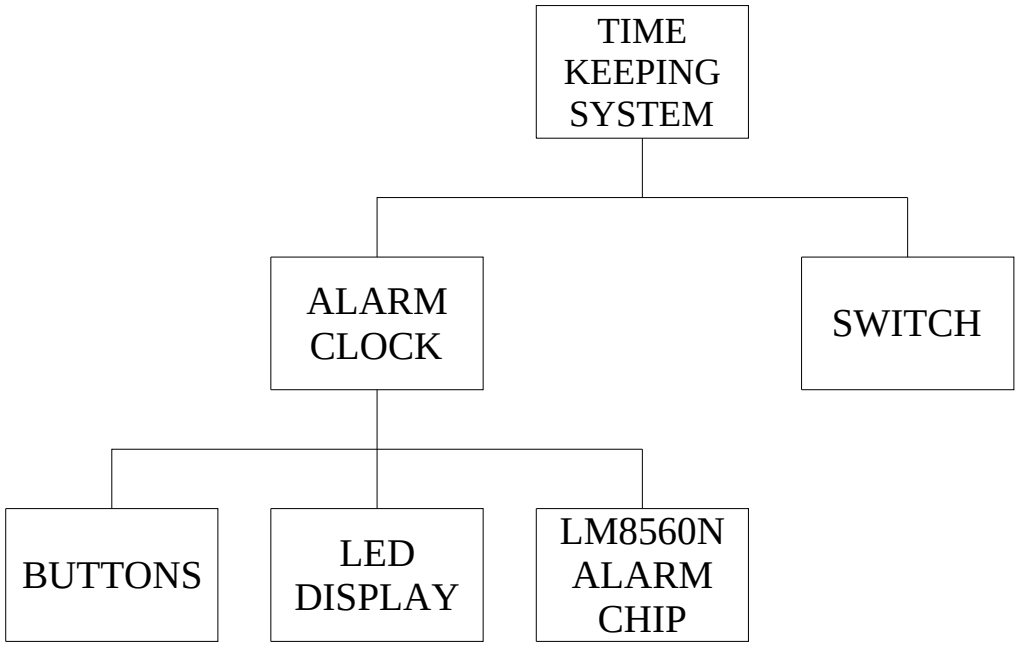


Pet Sensing System

Pet Detect Program



Time Keeping System



Time Keeping System

- RTC
  - We have chosen not to use it
    - Complicated programming
    - Odd interfacing with microcontroller
  - Given more time, it most likely would have been usable

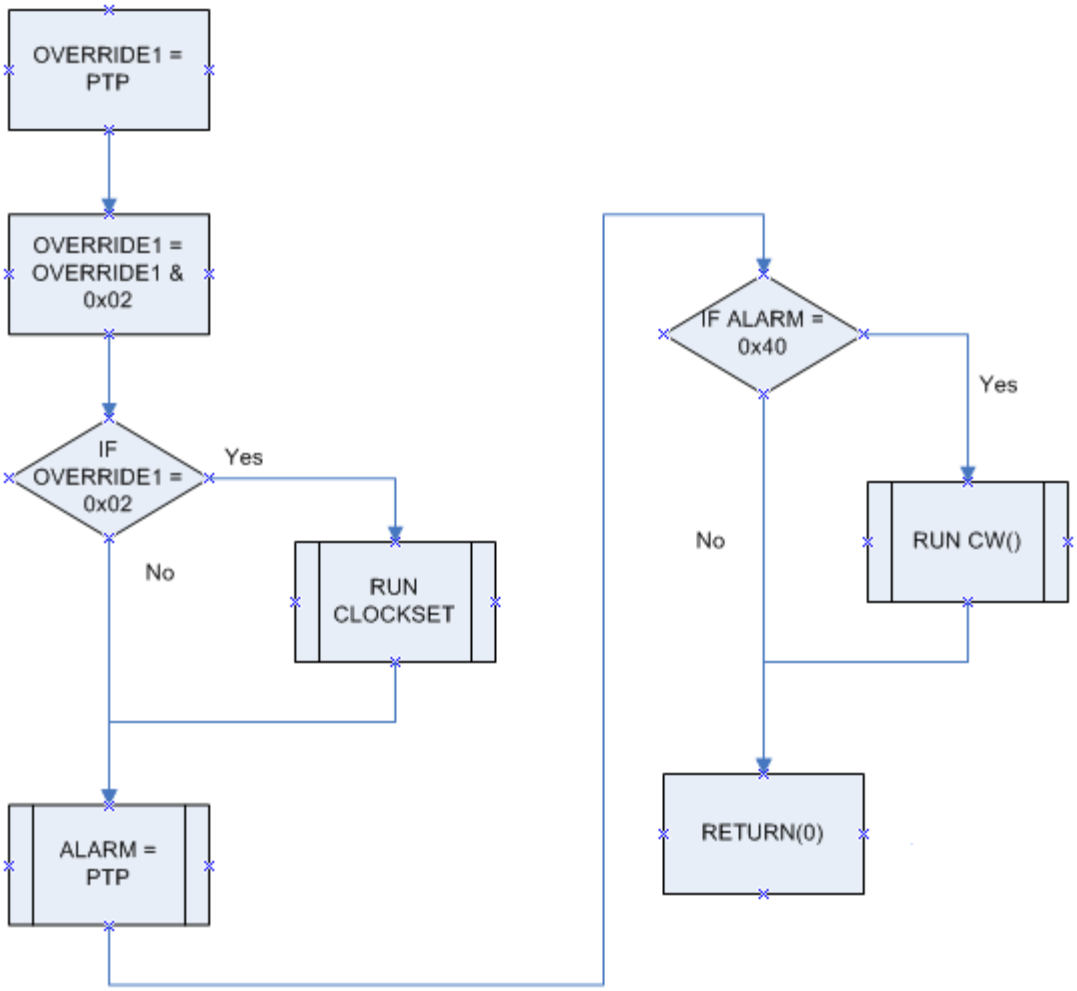
Time Keeping System

- Alarm clock chips
  - Extremely easy to interface
  - Some capable of outputting multiple alarms
  - Has dedicated pins for every function
    - Minute pins
    - Hour pins
    - Segment pins
    - Colon out pin

Time Keeping System

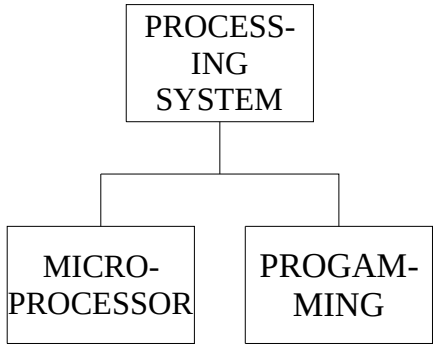
- New Requirements
  - Directly interfaces with the 7-Segment LED display
    - Eliminates tons of code
- Requirement fulfillment
  - Allows user to program feeding time
  - Tells the motor to rotate

Feeding Time



Processing System

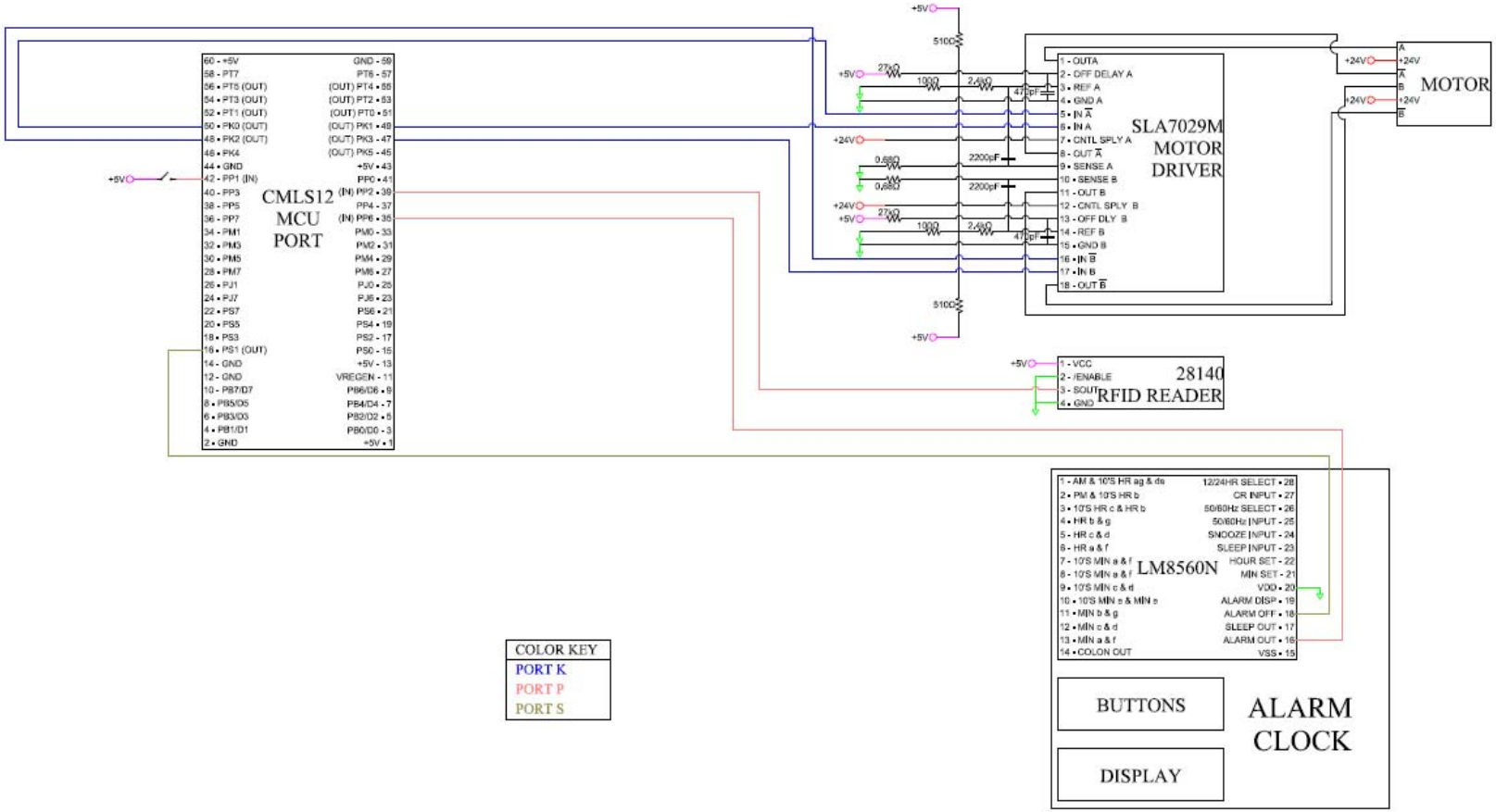
- Requirements
  - Interface with motor
  - Interface with RFID reader
  - Interface with timekeeping system



Processing System

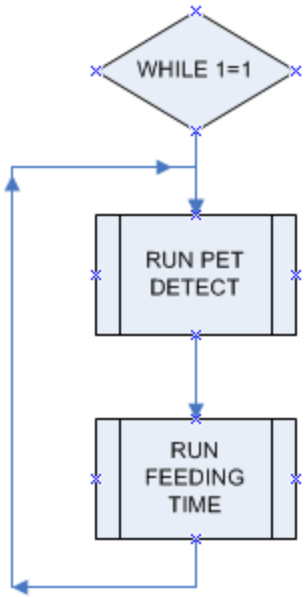
- WHY CML12S for development?
  - 91 I/O pins
    - Not using RTC anymore
  - 4 kB of EEPROM
  - 512 kB of Flash EEPROM

Processing System



Processing System

- MAIN PROGRAM
  - Calls the pet detect and feeding time programs



What Works

- Pet sensing system
  - Restricts forbidden pet
  - Sets our product apart
- Enclosure prevents pets from flipping it over or reaching the future feedings in any way
- Motor turns specified distance

Remaining Issues

- RFID tag is not as quick as we would have liked
  - Aluminum has reduced the sensing range of the RFID reader
- Tray moves less freely and with more resistance than we would like
- Alarm function

Next Phase of Development

- Use actual alarm clock chip
- Find material for enclosure that doesn't reduce the sensing range
- Improve tray movement

Conclusion

- Majority of our original design goals were met:
  - Simple user interface
  - Allows for portion control
  - Prevents future feedings from being reached
  - Prevents a forbidden pet from eating

Acknowledgements

- We would like to thank
  - Dr. Salah Badjou (Professor, Wentworth Institute of Technology)
  - Christine Cattoggio (Administrative Assistant, Axis New England)
  - Joseph Diecidue (Technician, Wentworth Institute of Technology)
  - Roger Forester (Technician, Axiom Manufacturing)
  - Dusty Nidey (Technician, Axiom Manufacturing)
  - Captain Timothy Johnson (Professor, Wentworth Institute of Technology)
  - Ross Kaplan (Student, Wentworth Institute of Technology)
  - Peter S. Rourke (Professor, Wentworth Institute of Technology)
  - Noah Vawter (Research Assistant, MIT Media Lab)
  - Robert Villanucci (Professor, Wentworth Institute of Technology)
  - Sanley Yuen (Application Engineer, LIN Engineering)

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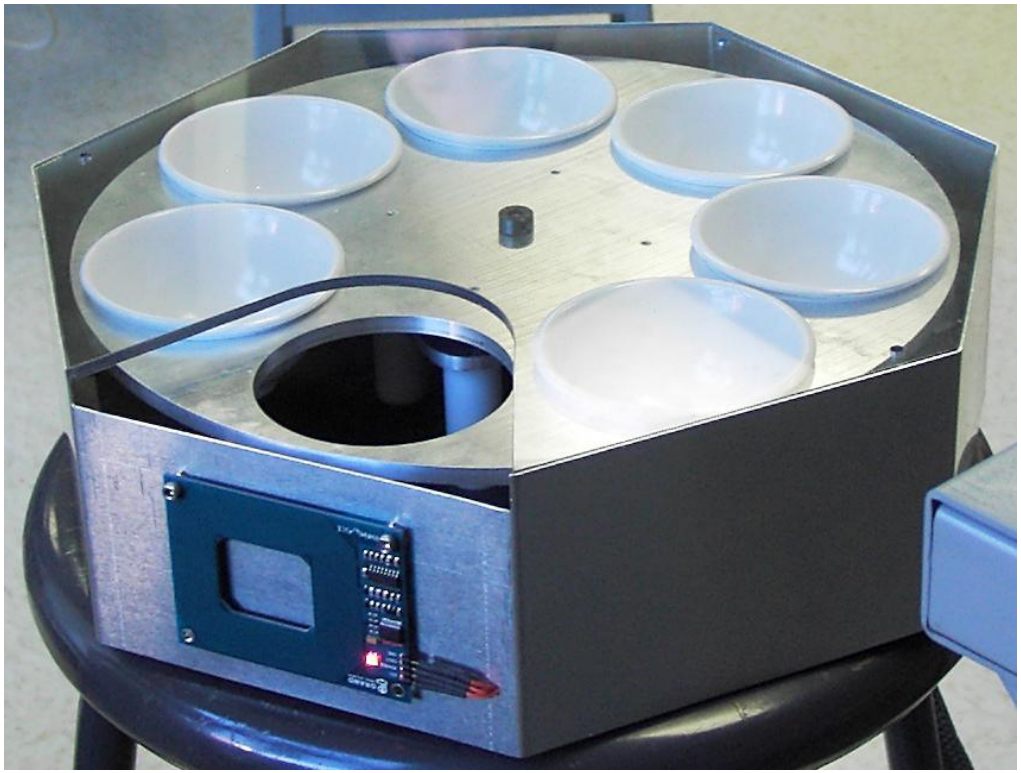
Questions or comments?

Thank you!!



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