ArdiChef Project

The Automated Kitchen Cooker

Started By: Thomas G (12/2014)

Table of Contents

1. INTRODUCTION

The ArdiChef project will reside within http://www.github.com/tgit23/ArdiChef/

1.1 Software

The software will mostly be written using the Arduino programming software package along with the "Processing" programming language.

1.2 Control

The ArdiChef project will be controlled using the Arduino project (http://www.arduino.cc/) micro-controller board and mimic a lot of the 3D RepRap printer project technologies.

1.3 Hardware

- ✔ Repository of Models - http://www.github.com/tgit23/Ardichef/ → Hardware/
- ✔ Bill of Materials

Many of the hardware parts are printed using a 3D printer while some will need to be purchased. Currently all 3D printed parts are designed in Google Sketchup and stored at

2. FOOD DISPENSERS

2.1 Granular Foods Dispenser (GFD-28BYJ)

Granular foods like sugars and spices can be dispensed using what I'd call the Gumball approach. A circular plate with holes in it rotating to a covered drop-hole.

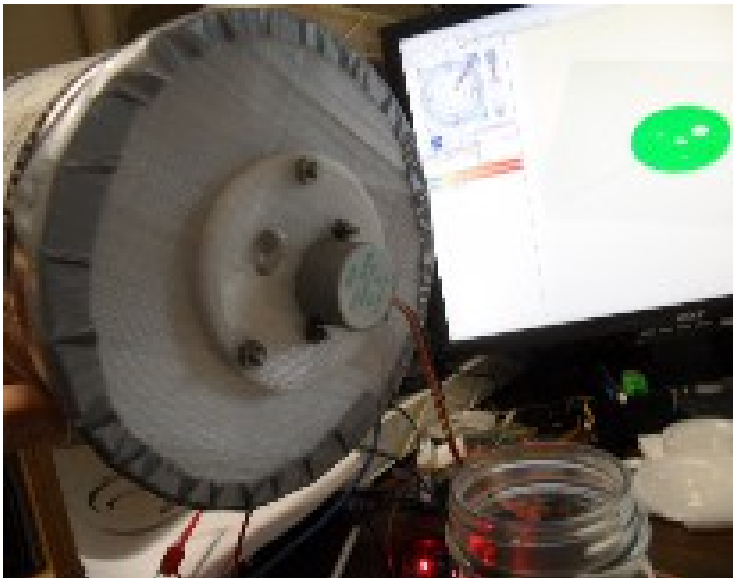
2.1.1 1-Gallon Can Granular Foods Dispenser (GC-GFD-28BYJ)

The 1-Gallon granular food dispenser requires

- ✔ One Gallon Tin Can with a base diameter that measures 16.125 inches
- ✔ 28BYJ-48 5Vdc 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board
- ✔ 3D Printer for printing the following parts @ http://www.github.com/tgit23/ArdiChef → /Hardware/GranularDispensers

File-Name	Google Sketchup	Thumb	Description
MotorMount.skp	2014 - Inches		1) The 28BYJ Stepper motor is bolted into this motor mount (Shaft up)
DispGear_4inHoles.skp	2014 -Inches		2) The Disp (Dispense) gear is placed on the motor shaft
GallonCanBase_6pt125inchBase.skp	2014 - Inches		3) The "MotorMount/Stepper/DispGear" assembly is then bolted to the CanBase 4) The Assembly is then attached to the bottom of the One-Gallon tin can.

MotorMountSpout.skp	2014 - Inches		5) Optionally – A spout holder can be attached to the MotorMount under the dispensing hole.



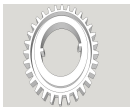
2.2 Powder Foods Dispenser (PFD-28BYJ)

2.2.1 1-Gallon Can Powder Foods Dispenser (GC-PFD-28BYJ)

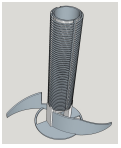
The 1-Gallon powder food dispenser requires

- ✔ One Gallon Tin Can with a base diameter that measures 16.125 inches
- ✔ 28BYJ-48 5Vdc 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board
- ✔ 3/4" Shedule 80 PVC Pipe threaded and notched the height of the tin can
- ✔ 3/4" PVC Pipe Nut (Created by cutting a PVC cap)
- ✔ 3D Printer for printing the following parts located at http://www.github.com/tgit23/ArdiChef/ → Hardware/PowderDispensers/GallonCan_ThreeQtrPipe

File-Name	Build Instructions
MotorMountGearBox.skp 	1) The 28BYJ Stepper motor is bolted into this motor mount gear box (Shaft up) 
MotorGear.skp 	2) The MotorGear is placed on the motor shaft
PipeDriverGear_24D.skp	3) The PipeDriverGear is dropped freely into the MotorMountGearBox.



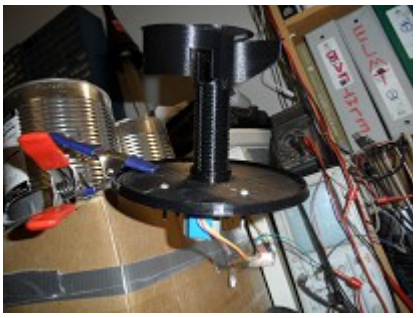
DispenserPipe_24D_Complete.skp



CanBase_24D_1Thread.skp

4) The MotorMountGearBox with PipeDriverGear and MotorGear Assembly is then bolted to the bottom of the CanBase.

5) The Dispensor is then Threaded Through the CanBase



2.2.2 Cambells 26.25Oz Family Size Can Powder Foods Dispenser (CC-PFD-28BYJ)

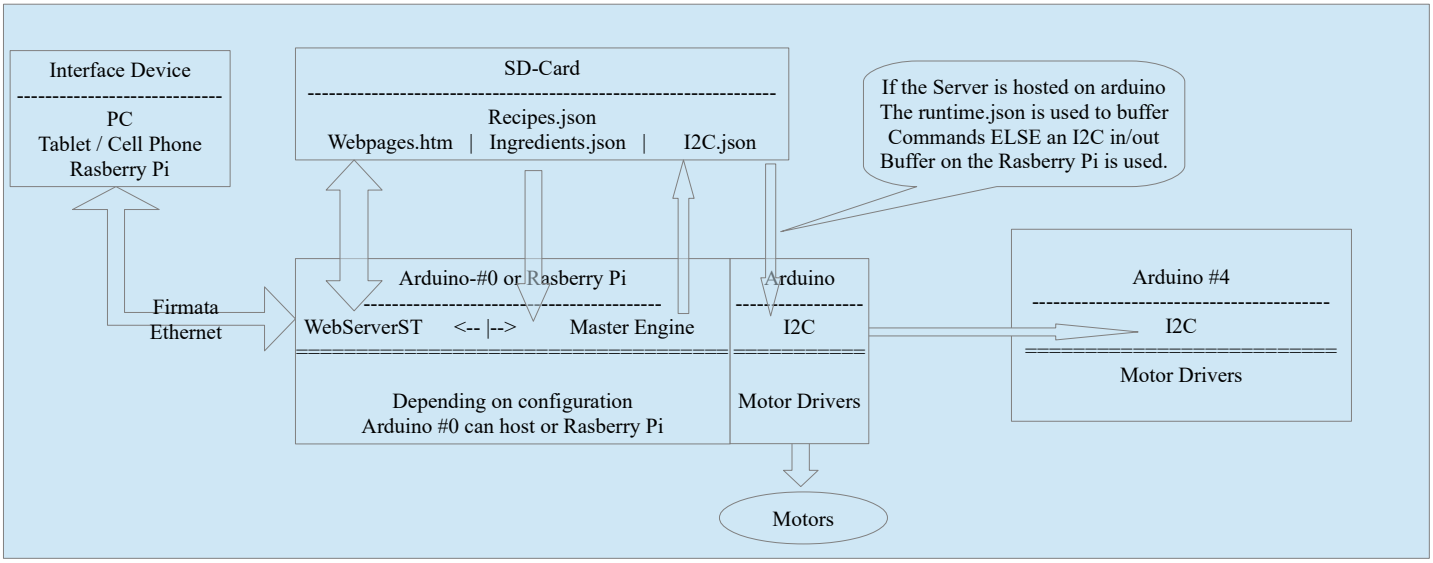
The Family Size Cambells Soup Can powder food dispenser requires

- ✔ One Family Size Cambells Soup Can with a base diameter that measures 3 3/8 inches
- ✔ 28BYJ-48 5Vdc 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board
- ✔ 1/2” Shedule 80 PVC Pipe threaded and notched the height of the tin can
- ✔ 1/2” PVC Pipe Nut (Created by cutting a PVC cap)
- ✔ 3D Printer for printing the following parts located at http://www.github.com/tgit23/ArdiChef/ → Hardware/PowderDispensers/Cambells_26.26OZ_HalfInchPipe

File-Name	Google Sketchup	Thumb	Build Instructions
MotorMountGearBox.skp	2014 - Inches		1) The 28BYJ Stepper motor is bolted into this motor mount gear box (Shaft up)
MotorGear.skp	2014 -Inches		2) The MotorGear is placed on the motor shaft from */PowderDispensers/GallonCan_ThreeQtrPipe*
PipeDriverGear.skp	2014 - Inches		3) The PipeDriverGear is dropped freely into the MotorMountGearBox.
Scrapper.skp	2014 - Inches		4) A 1/2” Schedule 80 PVC pipe is threaded the height of the gallon can in use 5) Using a dremel with grinder stone create 2-notches vertically along the pipe for the DriverGear 6) The Scrapper is attached (glued) to the top of the 1/2” Threaded and notched PVC pipe.
CanBase_Campbells26.25OZ.skp			7) A PVC Nut (A cut in half PVC Cap) is glued into the CanBase 8) The CanBase is then attached to the bottom of a one-gallon tin can 9) The “MotorMountGearBox/MotorGear/PipeDriverGear” assembly is bolted to the CanBase. 10) The Threaded and Notched “PVC-Pipe/Scrapper” is threaded down the CanBase Nut till the PipeDriverGear's Notches catches the Notches in the PVC pipe.

3. SOFTWARE

3.1 Architecture



- ✔ Hardware
  - ○ Interface Device = Any device with a web browser
  - ○ Arduino's = A master Arduino(#0) and any other Arduino's numbered according to their I2C address
  - ○ Storage = SD-Card connected to Arduino #0

- ✔ Software
  - ○ WebServerST = Renders html pages on the SD-Card, Parses AJAJ request that trigger the Master Engine
  - ○ Master Engine = Processes requests; using Recipe.json & Ingredient.json data and outputs to → runtime.json
  - ○ I2C communications
    - ▪ On Arduino #0 = Transmits action commands on the I2C communication bus
    - ▪ Other Arduino's = Recieves action commands
  - ○ Drivers = Transforms “action commands” into motor activation

3.2 Files

- ✔ Web-Pages
  - ○ index.htm = Section (Buttons “ingredients”, “recipes”, and “manual”); Section (Buttons for all “favorite” recipes)
  - ○ ingredients.htm = HMI type display with ingredients JSON and entries/buttons for Ingredients.json file editing
  - ○ recipes.htm = Load, Edit, Add and Execute (IE. Send to Engine); various recipes files

3.2.1 Index (json/htm)

- ✔ Top Section will have 3-Buttons to access other htm pages; “Recipes”, “Ingredients”, and “Manual” (i.e. for manual control)
- ✔ Bottom Scroll-able Section will have dynamic instantly run recipe buttons part of a category known as “favorite” recipes
  - ▪ Favorite recipe names will be stored in index.json and have a “Remove” and “Portion Size” button/fields.

3.2.2 Ingredients (json/htm)

A. Ingredients.htm

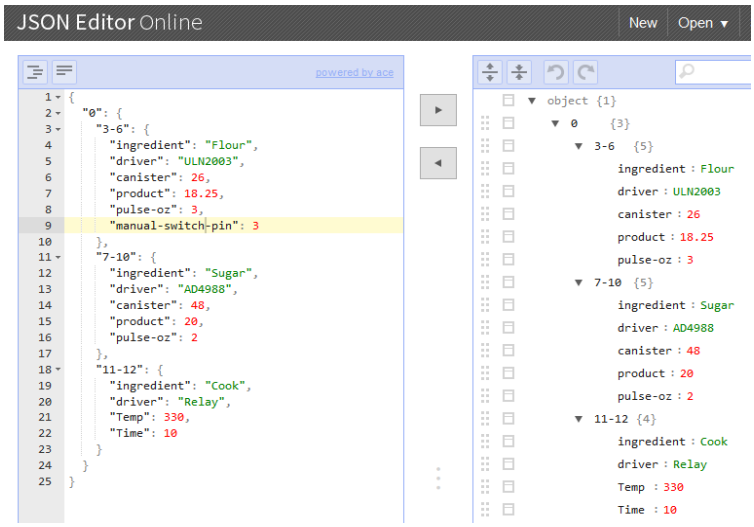
- ✔ HMI graphical view of Canisters, Cooking and stuff that make up the ArdiChef.
  - ○ Canisters should graphically show their current product level and at the top show their total capacity.
  - ○ Each information field should be editable by clicking on it
  - ○ Also include an “Add” button to add new Ingredient/Operation

```
FLOUR          SUGAR
-------------  ======
|           |  |      |
```

motor		motor	
driver		driver	
pulze-oz		pulse-oz	
manual pin		manual pin	

B. Ingredients.json

- Top object ID = Arduino # (IE. 0 for master or I2C address #)
- Digital Pins = The digital pins used by a dispenser/operation (e.g. 1-4 or 1,5,8 or etc...)
- Ingredient = A text name for product or operation
- Driver = The driver module name to use for motor activation; Different drivers will require more/dynamic settings
  - 28BYJ
    -



3.2.3 Recipes (json/htm)

- ✔ Recipes.htm
  - Loads recipes.json behind the scenes (AJAJ) and display as many recipe-blocks as possible; Each block having
    - Name = Recipe Name
    - "Portion" = Serving Size
    - "Edit" = Open 'this' recipe in "Recipe.htm" for editing and/or removal
    - "Favorite" = Add Recipe name to 'index.json' to display it on the home page
  - "Add" button to allow adding new recipes
  - Recipes.htm will contain javascript to organize, sort, and find recipes

- ✔ Recipes.json - All JSON Recipes will initially be one file (may break apart later as project matures)
    - "Run" button – to execute the recipe
    - "Portion" field – to proportionate the recipe
    - "Favorite" button – to add the recipe to "favorites" on the home page
    - "Edit" button – to load a new 'htm' page that will
- ✔ RecipeEdit
  - May be implemented as a pop-over screen on the same web-page (this would be the ideal way to handle it, I think.)

3.3 Implementation

- ✔ WebServerST
  - Must contain the ability to:
    - Serve GET files - for HTML page requests
    - Serve AJAJ files - for AJAJ page data
    - POST - Ability to trigger events(ie. functions) on the Master Engine
- ✔ Master Engine
  - Steps
    - Stream through recipes.json and find the recipe to operate on
    - Calculate the portion size
    - Stream through ingredients.json to decode the recipe to driver signals (recipe → I2C.json)
    - Build the I2C.json (i.e. driver messages) file and save it in the /I2Cstack so drivers can pick it up and execute
- ✔ I2C
- ✔ Drivers
  - Reads in commands from the I2Cstack and executes them (i.e. produces motor signals)

3.4 Future Plans

- ✔ ArdiChef.com itegration
  - ○ Add ability send current inventory and suggest recipes to/fro Ardichef.com
  - ○ Add ability to share your recipes with everyone
    - ▪ Perhaps tap into an existing: food.com, myfridgefood.com, and etc...?

  - ○ Web Server
    - ▪ Arduino -or- Rasberry Pi 2 Model B will be utilized as the Web-Host Server

    - ▪ The host will store
      - ▫ Recipes XML = Organize at least 3-hierarchy levels to contain a cooking reciepe
      - ▫ Hardware Setup XML = Which pins are connected to which dispensor models and ingredient contained there-in
      - ▫ Track Amount of Ingredients XML = Amount left inside the canister??? (May skip this for now)

    - ▪ Host Pages

      - ▫ Recipe (An “add”/”run” button on recipe browser)
        - ▫ Category - Breads
        - ▫ Name - Pancakes
        - ▫ Attribute - Blueberry (May be nice for fine adjustment or personality adjustments: Like: Drink->Coffee->MyName)
          - · Ingredient Amount (Cup, Oz, Lb, etc...)
          - · Ingredient Name (Flour, Sugar, etc..)

  - ○ Web browser
    - ▪ The web browser will allow
      - ▫ Ability to upload recipes

4. Up For Discussion

1) 4- Canisters into one spout or 4-spouts together
2) Turn-table or Conveyor Belt
   1. Turn-Table = Rotate bowl on circular table or rotate ingredients on circular table
   2. Conveyor Belt = Use bicycle tube as a food conveyor belt from start of ingredient canister row to an end drop position
3) Mixer on mixing bowl or over-head?

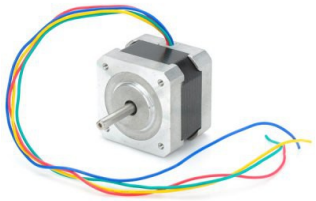
5. Bill Of Materials (BOM)

5.1 Tools

- ✔ 3D Printer

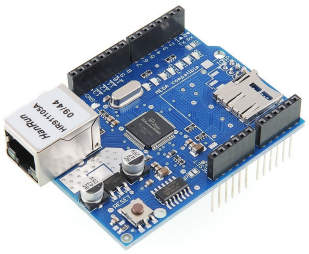
5.2 Materials

5.3 Original Purchases

Qty/SKU/Price	Product Name / Description	Picture
(2) 106842801 $30.54 www.gearbest.com	GZGW09 3D Printer Reprap Stepper Motor Driver Module Works with Official Arduino GZGW09 3D Printer Reprap Stepper Motor Driver Module Step angle: 1.8 degree Rated voltage: DC 4.83V Rated current: 0.84A Phase impedance: 5.75 Ohm + / - 10 degree centigrade Phase inductance: 9.3 mH + / - 20 degree centigrade (1kHz 1V RMA) Holding torque: 0.48 Nm Shaft diameter: 5mm / 0.188 Shaft length: 20mm Motor height: 34mm Number of lead wire: 4 wires Product Weight: 0.22 kg Package Weight: 0.23 kg Product Size(L x W x H): 5.8 x 4.2 x 4.2 cm / 2.28 x 1.65 x 1.65 inches Package Size(L x W x H): 8.0 x 6.0 x 5.0 cm http://www.gearbest.com/development-boards/pp_101725.html http://www.dx.com/p/gzgw09-3d-printer-4-wire-stepper-motor-silver-black-222200#.Vk0qpuKaUQk	
(3) NZ0019501 $11.22 www.gearbest.com	28BYJ-48 5V 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board Google Sketchup 3" x 5 3/16" Rectangular Drive Hole	
(2) NZ0049801 $75.24 www.gearbest.com	Arduino MEGA2560 RepRap Circuit Sets for 3D Printer Ramps Package Contents: 1 x MEGA2560 Circuit Sets 1 x Ramps 1.4 4 x A4988 1 x USB Cable	
(1) 277147 $4.99 www.dx.com	Double Tip 21cm Dupont Cable - Black + Multicolored (70 PCS)	

(1) 145357 $7.91 www.dx.com	3-Pin Power Adapter Socket with Rock Switch for DIY Project - Black + Red (5-Piece Pack)	
(1) 344826 $4.80 www.dx.com	S401 1/4" Water Flow Sensor for Dispenser / Coffee Machine - White	
(1) 263660 $10.99 www.dx.com	DIY Copper Breadboard DuPont Connection / Test Cables - Multicolored (200 PCS)	
(1) 123648 $1.46 www.dx.com	2.54mm Mini Jumper Connector - Black (50-Piece Pack)	
(1) 162180 $3.91 www.dx.com	1-Pin Female to Female DuPont Cables for Arduino (2 x 40 PCS / 21cm)	
(1) 206265 $1.77 www.dx.com	SZF303 Small Water Pump Motor Water / Oxygen Pipe / Tube - Transparent (100cm) Model SZF303 Quantity 1 Color Transparent Material Plastic housing Features Use for small fish tank oxygen supply; DIY project Specification Inner diameter: 0.2cm; Thickness: 0.4cm; Length: 100cm Application Small water pump pipe / tube English Manual/Spec No Packing List 1 x Water pipe Dimensions: 39.37 in x 0.16 in x 0.16 in (100.0 cm x 0.4 cm x 0.4 cm) Weight: 0.32 oz (9 g)	

(1) 232242 $2.41 www.dx.com	DIY Plastic Water Pump Line Tube - White (4 PCS) Brand N/A Quantity 4 Piece(s)/pack Color White Material Plastic Compatible Models Small water pump Application Used to connect small water pump Other Feature Outer diameter: 4mm; Inner diameter: 3mm Packing List 4 x Water pump line tubes Dimensions: 1.14 in x 0.71 in x 0.16 in (2.9 cm x 1.8 cm x 0.4 cm) Weight: 0.18 oz (5 g)	
(1) 203330 $4.99 www.dx.com	20904 Silicone Tube Pipe - Translucent White (5 Meters) Model 20904 Quantity 1 Color Translucent white Material Silicone Specification Outer diameter: 5mm; Inner diameter: 3mm; Thickness: 12mm; Working temperature range: -65'C~200'C Features Silicone tube Application Widely used for water dispenser, coffeemaker, electronic instrument, medical equipment, wine connection tube etc. English Manual/Spec No Packing List 1 x Silicone tube (5 meters) Dimensions: 196.85 in x 0.20 in x 0.20 in (500.0 cm x 0.5 cm x 0.5 cm) Weight: 2.82 oz (80 g)	
(2) 236808 $5.23 www.dx.com	HSYY01 Micro Gear Water Pump Motor w/ Hose - White + Silver $5.23 **Brand** N/A **Model** HSYY01 **Quantity** 1 **Color** White + Silver **Material** Iron casing + PVC **Specification** Working voltage: 4~12V; Working current: 0.8A; Motor diameter: 2.7cm; inlet opening outer diameter: 0.4cm **Features** Working voltage: 4~12V; Working current: 0.8A; Motor diameter: 2.7cm; inlet opening outer diameter: 0.4c. Water flow rate: Approx. 1.2L/M (5V) **Application** DIY project **English Manual/Spec** NO **Packing List** 1 x Motor 1 x Hose (100cm) Dimensions: 2.56 in x 1.69 in x 1.61 in (6.5 cm x 4.3 cm x 4.1 cm) Weight: 3.03 oz (86 g)	
(1) 229082 $5.92 www.dx.com	DIY Electric Motor Mini Water Pump $5.92 Brand N/A Quantity 1 Piece(s)/pack Color Silver + white Material Iron + copper + plastic Compatible Models N/A Application Testing, fish-farming, etc. Other Feature Inlet and outlet hole external diameter: 4mm; Rated voltage: 7.2V; DC voltage: 3~9V; Please note: No-load test should not take a long time; With plastic blade, Can't be inhaled impurities Packing List 1 x Pump Dimensions: 2.56 in x 1.61 in x 1.50 in (6.5 cm x 4.1 cm x 3.8 cm) Weight: 2.54 oz (72 g)	
(1) 300904 $8.48 www.dx.com	5.5V- 12V Submersible Water Pump - Black Voltage: 3.5-12V, head: 40-160cm. the maximum flow: 300L/H. 60 degrees below temperature resistant. - Continuous working life (24 hours non-stop work) more than 20000 hours, about 10 hours per day, water pump life for 8 years. - The inlet and outlet diameter is 8.3MM, the inner diameter 6.2MM. With 2 soft sucker, can be fixed freely. - Super mute, noise figure is 30dB Brand: N/A Quantity: 1-Piece Color: Black Material: ABS Dimensions: 1.89 in x 1.57 in x 1.06 in (4.8 cm x 4 cm x 2.7 cm) Weight: 2.52 oz (71.5 g)	

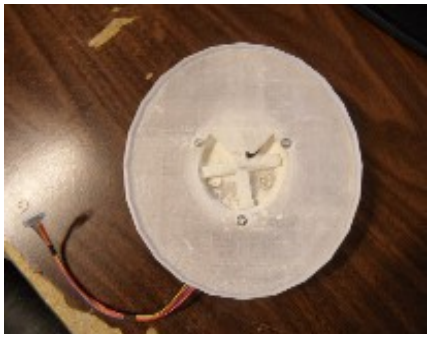
	Packing List: 1 x Pump (38cm-cable)	
(1) 185970 $6.49 www.dx.com	MPX08 Micro Liquid Gear Pump w/ Silicone Tube - White (DC 5V) Model MPX08 Quantity 1 Color White Material Plastic + Iron Features Start current: 2A; Perfect for DIY projects such as fish tank, model, etc. Packing List 1 x Micro pump 1 x Silicone tube (100cm) Dimensions: 2.56 in x 1.65 in x 1.54 in (6.5 cm x 4.2 cm x 3.9 cm) Weight: 3.28 oz (93 g)	
(1) $6.47	Desloo Ethernet Shield W5100 Micro-sd Card Slot for Arduino 2009 UNO Mega 1280 2560 Duemilanove http://www.amazon.com/Desloo-Ethernet-Micro-sd-Arduino-Duemilanove/dp/B00GIDHZHE/ref=lp_10904701011_1_1?srs=10904701011&ie=UTF8&qid=1448125387&sr=8-1	

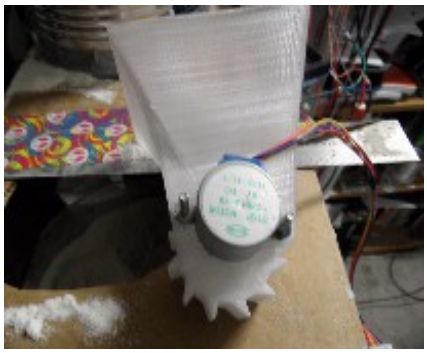
6. Failed Attempts For Reference

6.1 Powder Dispensing

Dispensing powder proved to be quite challenging

- ✔ Large holed Granular type approach – FAILED
- ✔ Funnel container – FAILED (Didn't attempt a super-long auger approach as it was thought to fail also)
- ✔ Large bottom "Water Wheel" type approach - FAILED




- ✔ Partial Solution "Top Down" – WORKS (But needs refinement – as per actual unit)
  - ○ Creating a scrapper that falls down as product is removed while scrapping product to a center drop hole.
  - ○ While this worked for flour – corn starch and small holed center (1/2" pipe) will most likely still be an issue
  - ○ Disadvantages
    - ▪ The scrapping gear must be held up while filling the cannister
    - ▪ The center shaft has large holes that leak while filling the cannister
    - ▪ A cap must be put on the end of the shaft to keep it from binding the gear
    - ▪ Filling with flour is more difficult due to motor being attached at the top
    - ▪ The flour did dispense well as shown above the can has been dispensed of flour completely without any intervention.

6.1.1 **OUTDATED** Gallon Can Powder Foods Dispenser (GC-PFD-28BYJ)

The 1-Gallon powder food dispenser requires

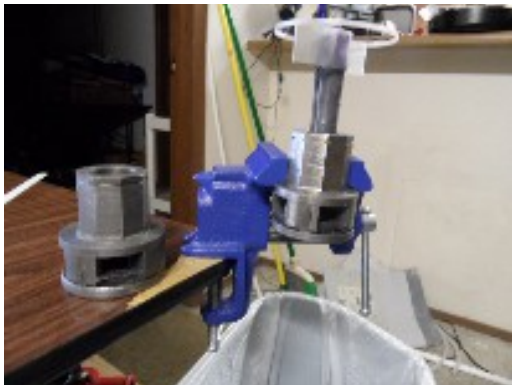
- ✔ One Gallon Tin Can with a base diameter that measures 16.125 inches
- ✔ 28BYJ-48 5Vdc 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board
- ✔ 3/4" Shedule 80 PVC Pipe threaded and notched the height of the tin can
- ✔ 3/4" PVC Pipe Nut (Created by cutting a PVC cap)
- ✔ 3D Printer for printing the following parts located at http://www.github.com/tgit23/ArdiChef/ → Hardware/PowderDispensers/GallonCan_ThreeQtrPipe

File-Name	Google Sketchup	Thumb	Build Instructions
MotorMountGearBox.skp	2014 - Inches		1) The 28BYJ Stepper motor is bolted into this motor mount gear box (Shaft up)
MotorGear.skp	2014 -Inches		2) The MotorGear is placed on the motor shaft
PipeDriverGear.skp	2014 - Inches		3) The PipeDriverGear is dropped freely into the MotorMountGearBox.

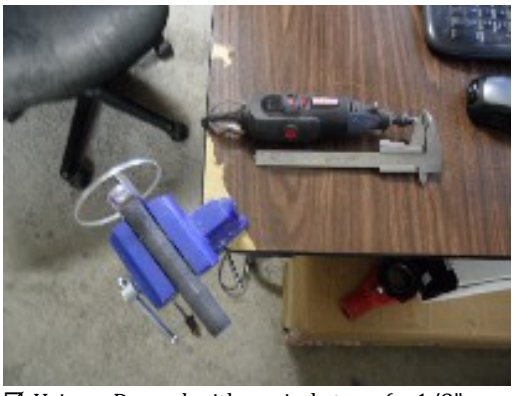
Scrapper.skp	2014 - Inches		4) A 3/4” Schedule 80 PVC pipe is threaded the height of the gallon can in use 5) Using a dremel with grinder stone create 2-notches vertically along the pipe for the DriverGear 6) The Scrapper is attached (glued) to the top of the 3/4” Threaded and notched PVC pipe.
GalCanBase_ThreeQtrNutBase.skp			7) A PVC Nut (A cut in half PVC Cap) is glued into the CanBase 8) The CanBase is then attached to the bottom of a one-gallon tin can 9) The “MotorMountGearBox/MotorGear/PipeDriverGear” assembly is bolted to the CanBase. 10) The Threaded and Notched “PVC-Pipe/Scrapper” is threaded down the CanBase Nut till the PipeDriverGear's Notches catches the Notches in the PVC pipe.

☑ 28BYJ Stepper Motor Bolted to **MotorMountGearBox.skp**
☑ **MotorGear.skp** attached to the shaft of 28BYJ Stepper
☑ **PipeDriverGear.skp** placed in the MotorMountGearBox.skp

☑ 3/4” Schedule 80 Threaded and Notched **PVC Pipe**
☑ **Scrapper.skp** glued to the top of the 3/4” PVC Pipe
☑ **GalCanBase_ThreeQtrNutBase.skp** with 3/4” PVC Cap nut



☑ Thread the 3/4” Schedule 80 PVC Pipe with a 3/4” pipe threader die - the length of the height of the gallon tin can minus the height of the attaching scrapper.



☑ Using a Dremel with a grind stone (~ 1/8” thick), notch the threaded 3/4” PVC pipe on both sides so the **PipeDriverGear.skp** locks rotation-ally to the pipe but freely slides vertically along the pipe.

☑ The stepper motor drives the **PipeDriverGear** which turns the PVC Pipe which rotates the attached **Scrapper** while the **Cans base with PVC nut** moves (via threads) the **scrapper/pipe assembly** from Top-to-Bottom.

☑ The rotating scrapper pulls the powder to the center of the PVC pipe (Drop-hole) while also pulling the scrapper a set distance down the can via the pipes threads and base nut.

6.1.2 **OUTDATED** Cambells 26.25Oz Family Size Can Powder Foods Dispenser (CC-PFD-28BYJ)

The Family Size Cambells Soup Can powder food dispenser requires

- ✔ One Family Size Cambells Soup Can with a base diameter that measures 3 3/8 inches
- ✔ 28BYJ-48 5Vdc 4-Phase 5-Line Stepper Motor with ULN2003 Driver Module Board
- ✔ 1/2” Shedule 80 PVC Pipe threaded and notched the height of the tin can
- ✔ 1/2” PVC Pipe Nut (Created by cutting a PVC cap)
- ✔ 3D Printer for printing the following parts located at http://www.github.com/tgit23/ArdiChef/ → Hardware/PowderDispensers/Cambells_26.26OZ_HalfInchPipe

File-Name	Google Sketchup	Thumb	Build Instructions
MotorMountGearBox.skp	2014 - Inches		1) The 28BYJ Stepper motor is bolted into this motor mount gear box (Shaft up)

MotorGear.skp	2014 -Inches		2) The MotorGear is placed on the motor shaft from */PowderDispensers/GallonCan_ThreeQtrPipe*
PipeDriverGear.skp	2014 - Inches		3) The PipeDriverGear is dropped freely into the MotorMountGearBox.
Scrapper.skp	2014 - Inches		4) A 1/2” Schedule 80 PVC pipe is threaded the height of the gallon can in use 5) Using a dremel with grinder stone create 2-notches vertically along the pipe for the DriverGear 6) The Scrapper is attached (glued) to the top of the 1/2” Threaded and notched PVC pipe.
CanBase_Campbells26.25OZ.skp			7) A PVC Nut (A cut in half PVC Cap) is glued into the CanBase 8) The CanBase is then attached to the bottom of a one-gallon tin can 9) The “MotorMountGearBox/MotorGear/PipeDriverGear” assembly is bolted to the CanBase. 10) The Threaded and Notched “PVC-Pipe/Scrapper” is threaded down the CanBase Nut till the PipeDriverGear's Notches catches the Notches in the PVC pipe.