ALEXA AUTOMATED PET FEEDER CRITICAL DESIGN REVIEW

GROUP 18

MEMBERS:

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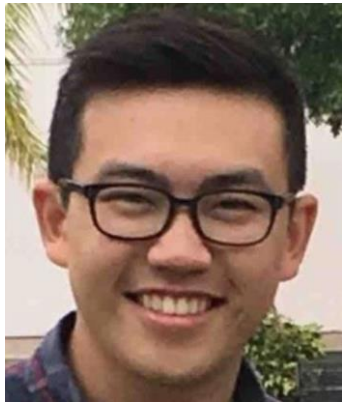
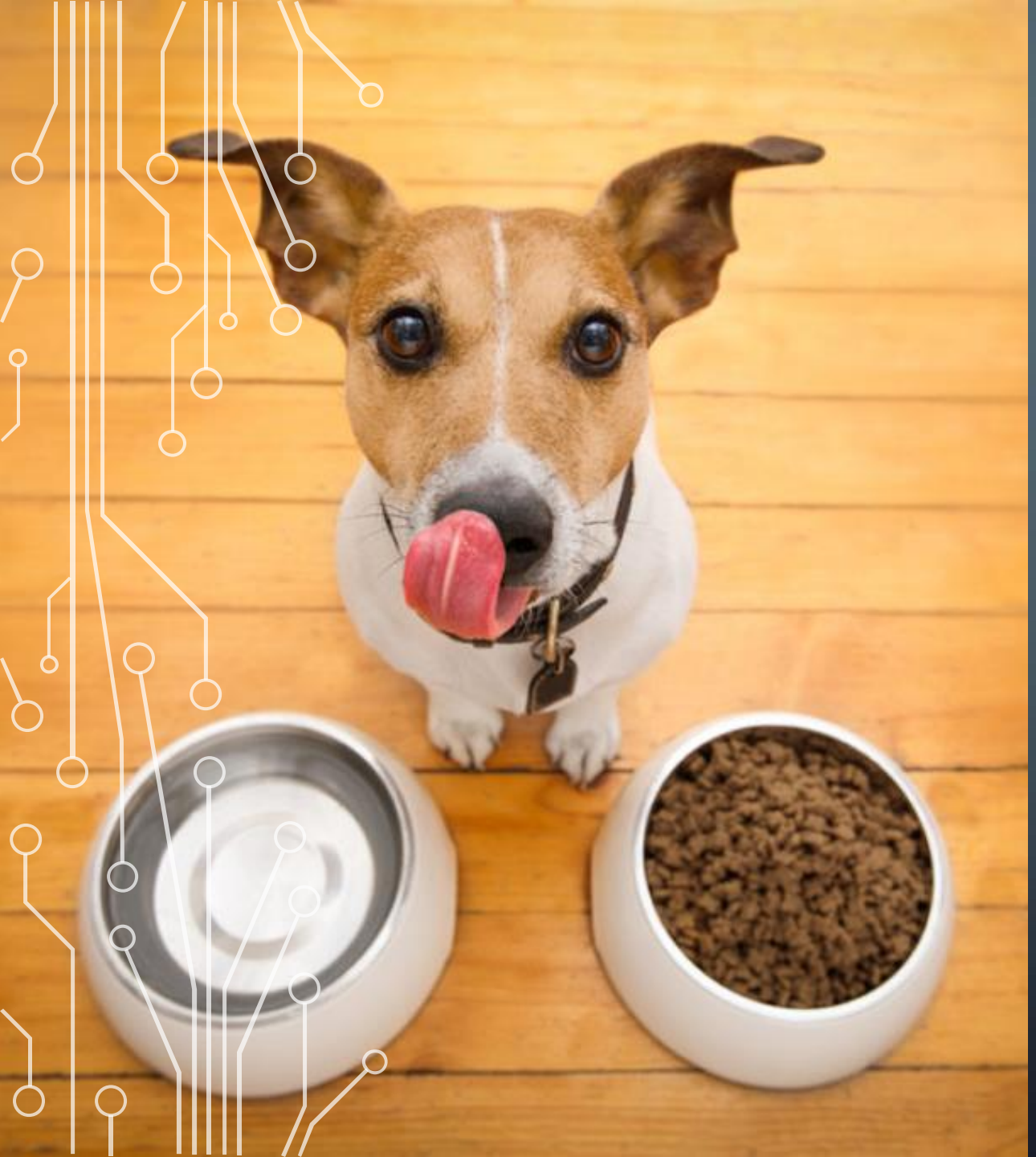




Introduction

- Create an Alexa-Enabled Pet Feeder
- Allow user to feed pet through Amazon Alexa
- See if the Pet has eaten their food through Alexa.

Goals and Objectives

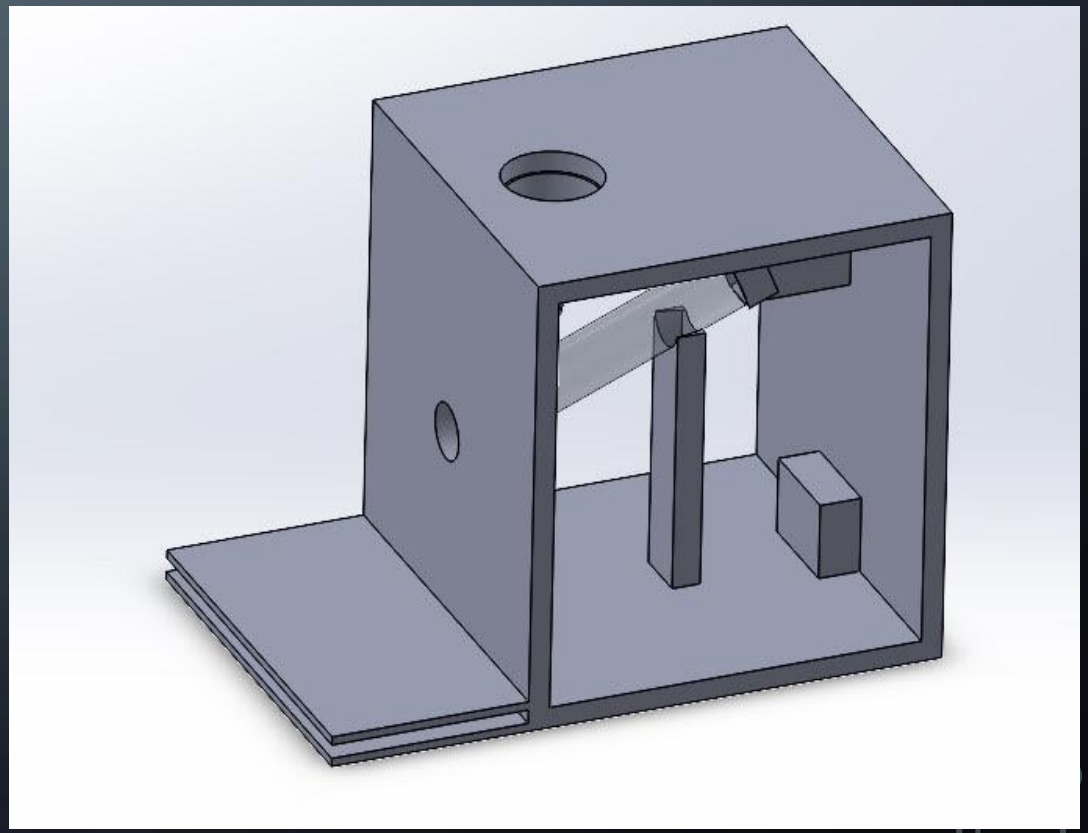
- To provide pet owners with a quick, easy, and hassle-free way to feed their pets
  - Eliminates the need to scoop and measure food for every meal
  - Touch free design doesn't leave the owner's hands smelling like pet food
- To allow owners to care for their pets while away from home
  - Provide piece of mind to owners who get stuck at a long day of work
  - A safer, more regulated alternative to building "food mountain" when leaving for multiple days
- To keep a pet on a routine feeding schedule with regulated food amounts
  - Many pets struggle from over feeding
  - Makes following veterinarian feeding advice easy

Specifications

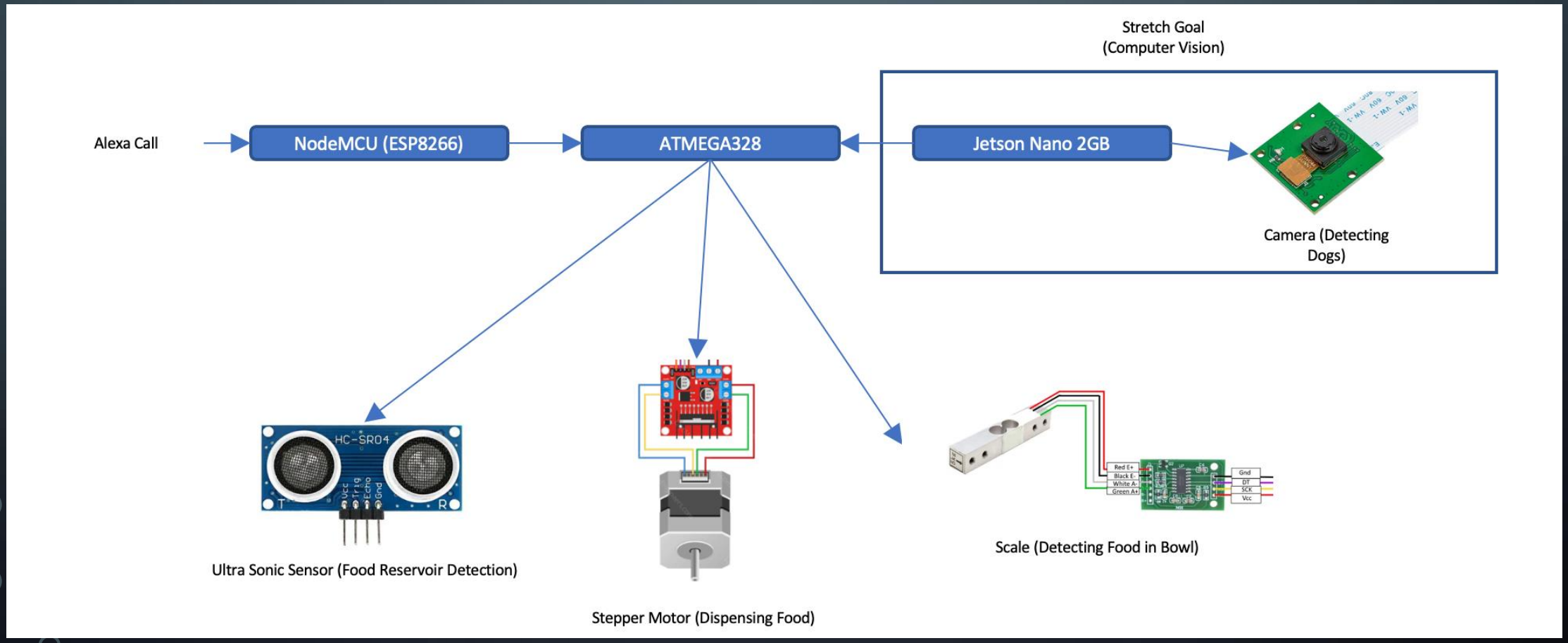
Requirement	Design Specification
Battery Life	The battery shall last a minimum of 1 week without being plugged in.
Wi-Fi Range	The range of the Wi-Fi/Bluetooth module shall cover all the home or at least 100ft.
Food Capacity	The pet feeder shall hold a minimum of 3 days or 6 meals worth of dry food.
Food Measurement Sensing	Utilizing the weight sensor, the unit shall dispense food with an 80% accuracy to the user food weight input.
Scheduling (Stretch)	The user shall be able to set the time and frequency for automated feeding with Computer Vision.
On Demand Feeding	The user shall be able to dispense food at any time using the app.
Food Supply Level Sensing	The unit will have an internal sensor to alert the user when the food supply is running low, with approximately 2 servings (1 days' worth) of food is left.

Design Overview

- Rectangular housing with integrated pressure plate, camera, and sensors
- Food reservoir fill port with lid
- Auger driven food dispenser
- Wireless, battery operated, and rechargeable
- Fully enclosed: pet tamper resistant



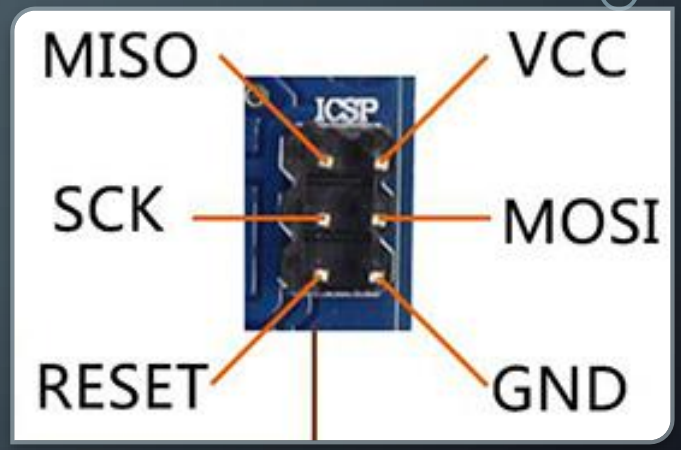
Design Overview (Continued)

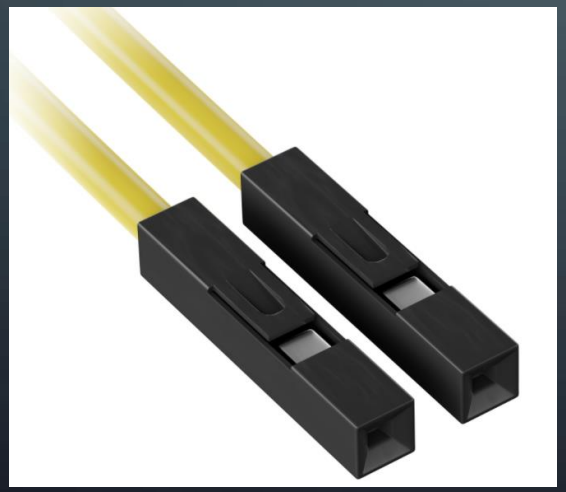


SOFTWARE INTEGRATION

ICSP- IN-CIRCUIT SERIAL PROGRAMMING

- Eliminate dip sockets from PCB
- On board programming

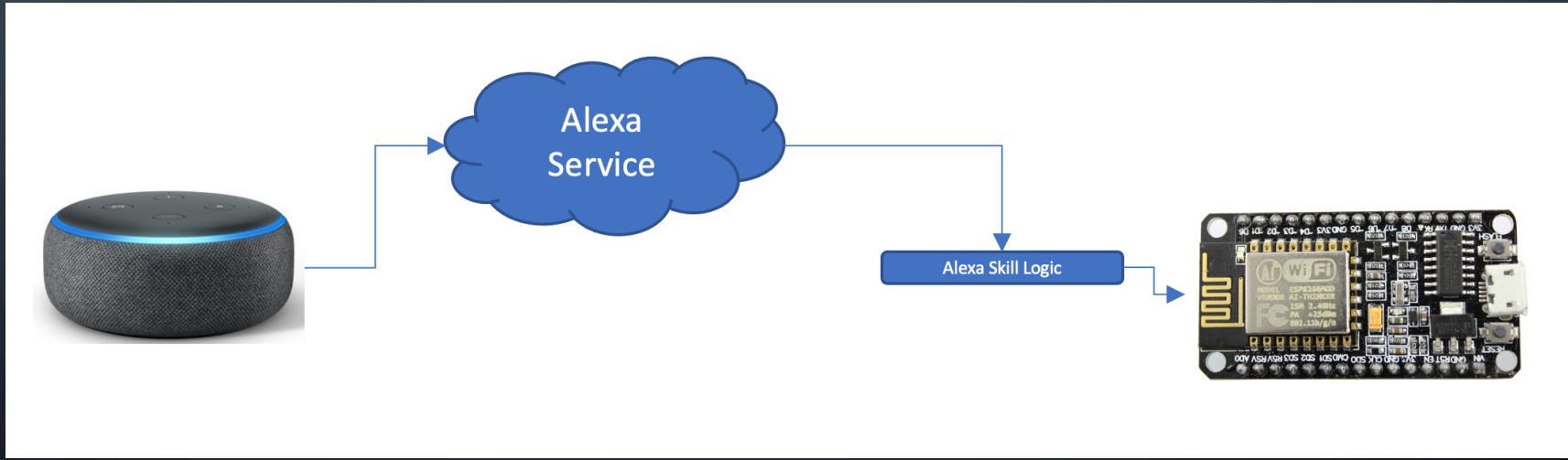




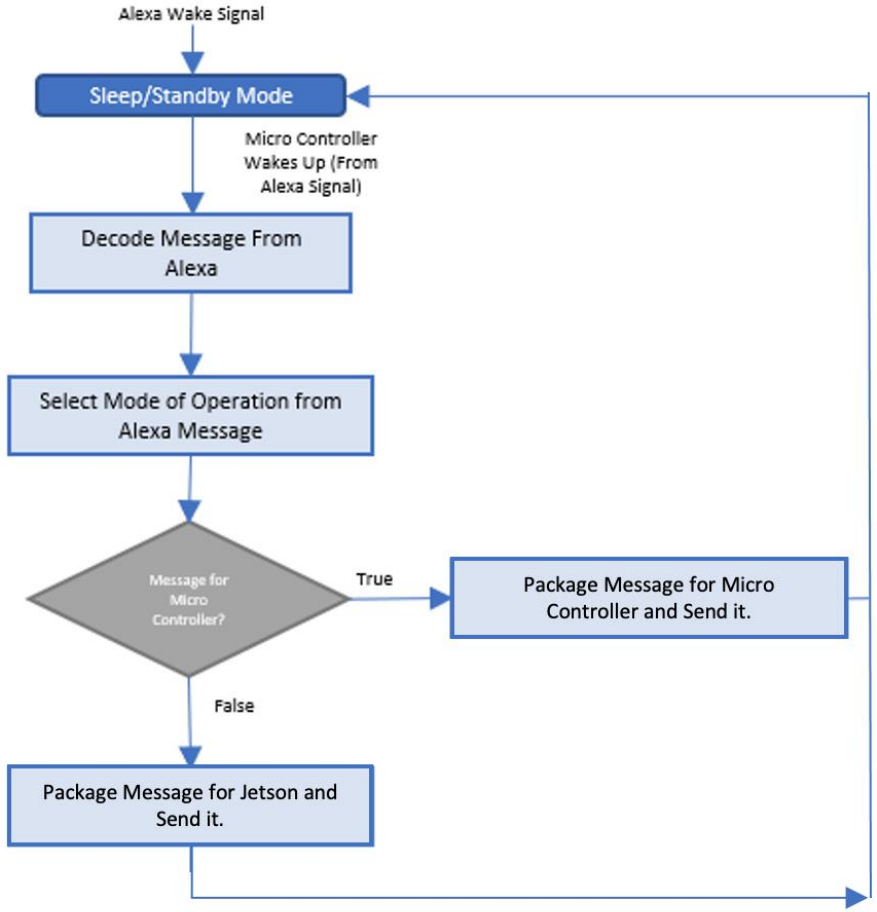
Programmer (Arduino Uno)	Target Board (ATmega328)
SCK (Pin 13)	Pin 19
MISO (Pin 12)	Pin 18
MOSI (Pin 11)	Pin 17
SS (Pin 10)	Reset
GND	GND
+5V	+5V

ALEXA INTEGRATION

- As discussed earlier, the NodeMCU will be the broker between Amazon Alexa and the Pet Feeder.

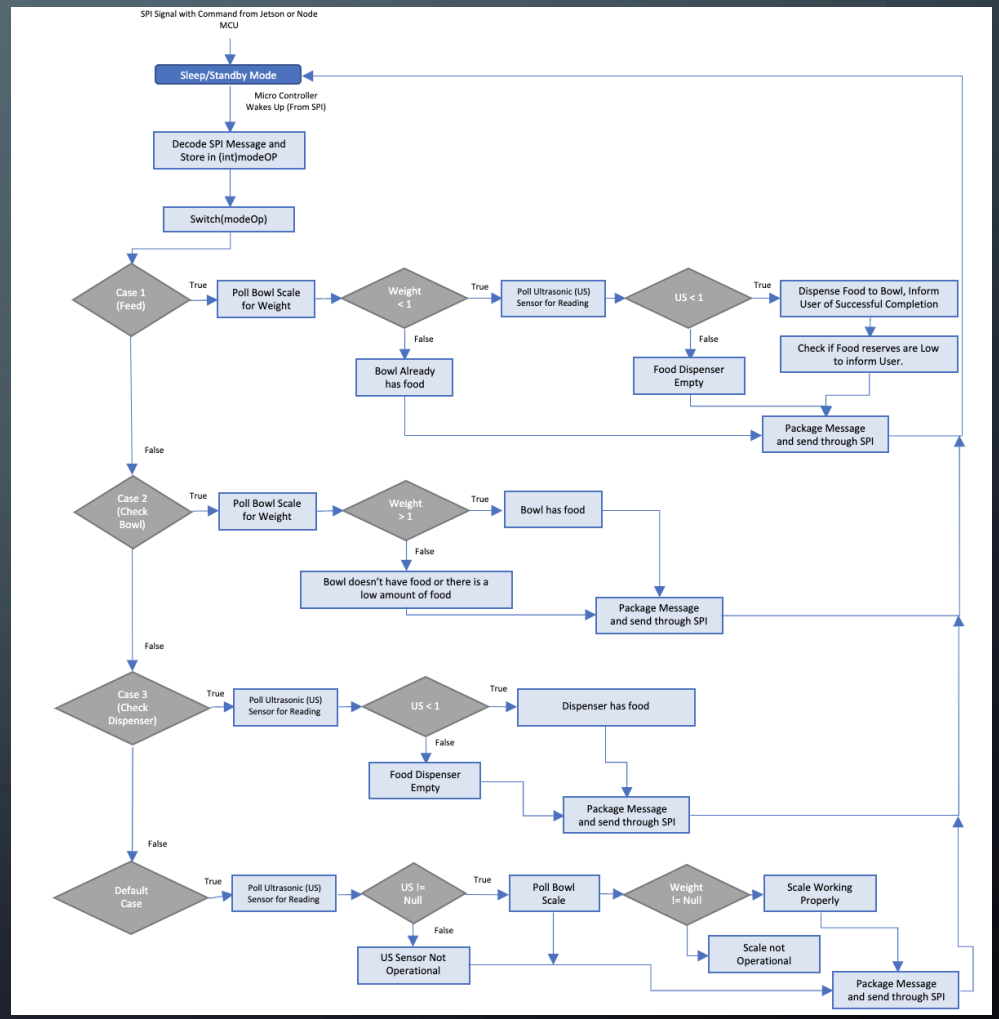


NODEMCU CODE BLOCK DIAGRAM

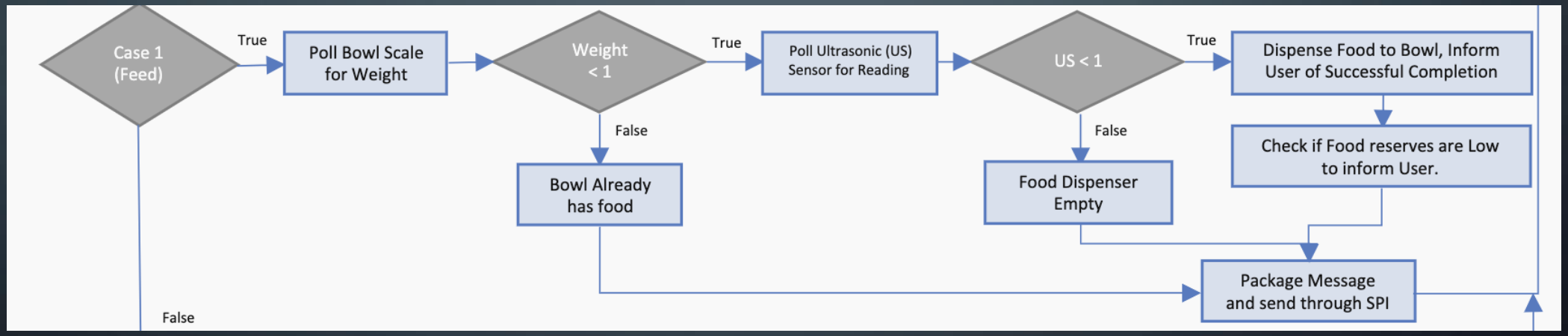


ATMEGA SOFTWARE BLOCK DIAGRAM

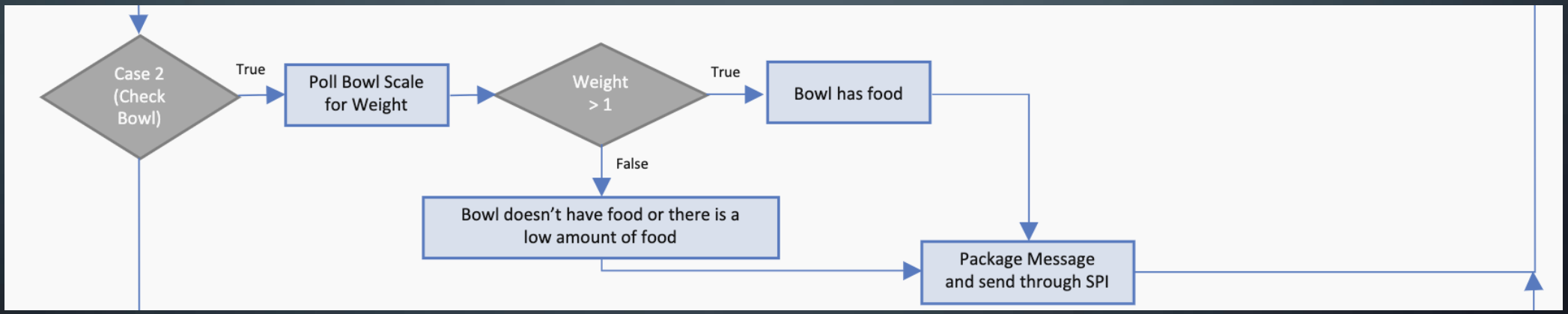
- The microcontroller will be on standby
- Once there is a request then there will be different switch cases



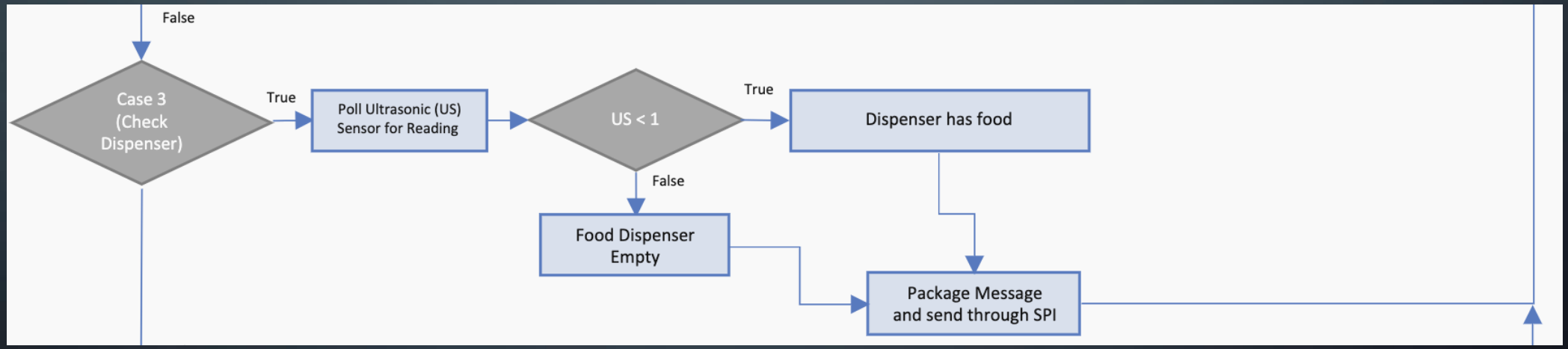
ATMEGA: CASE 1



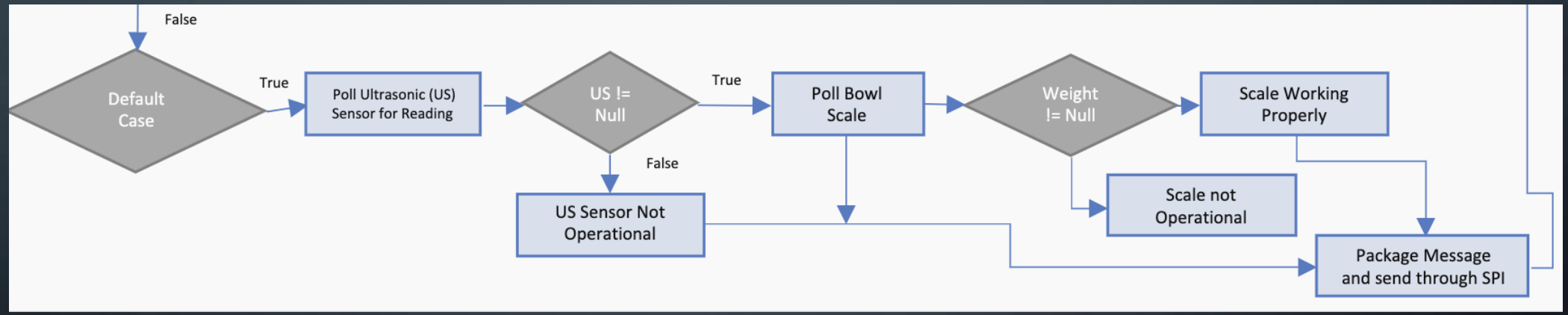
ATMEGA: CASE 2

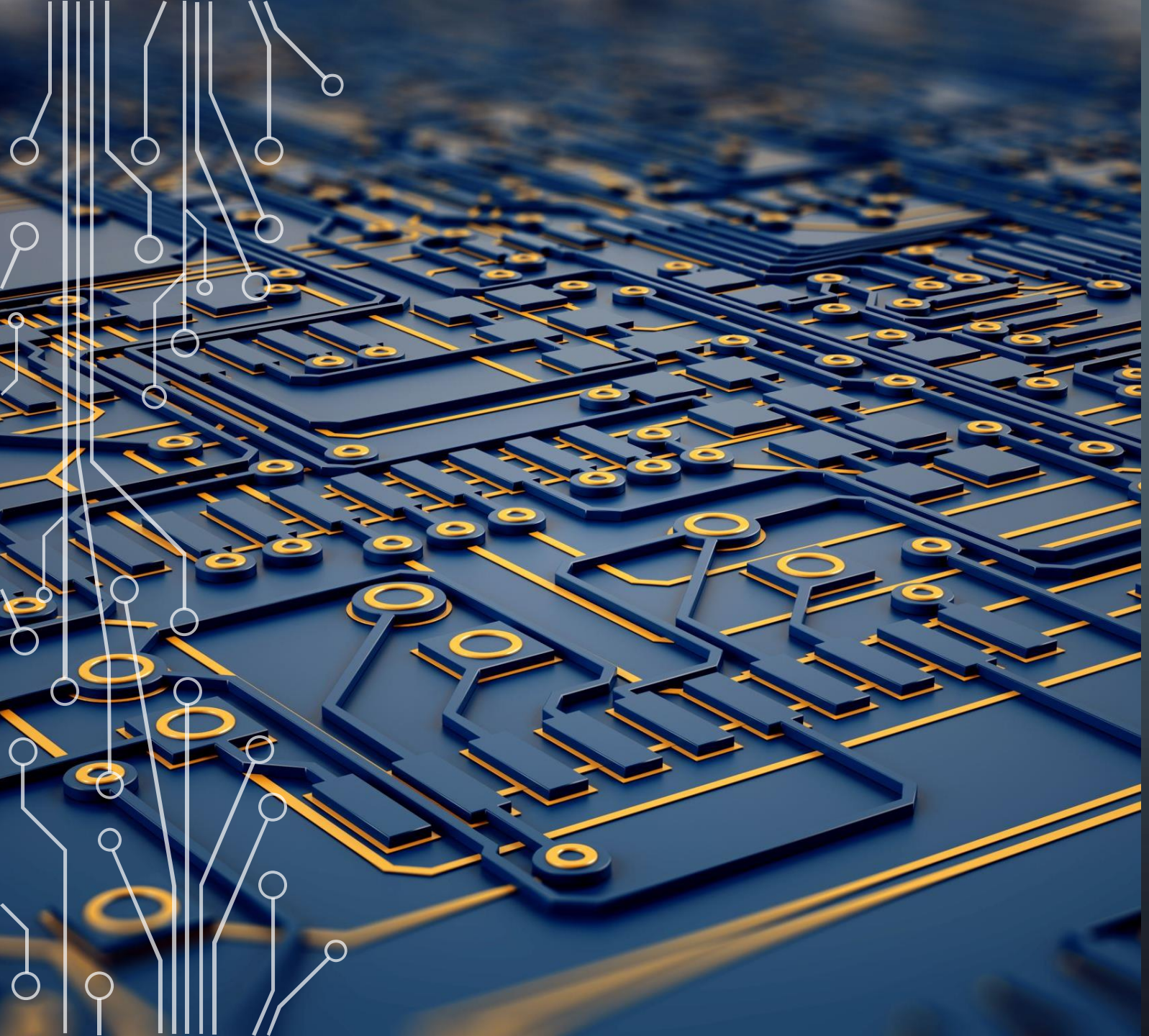


ATMEGA: CASE 3



ATMEGA: DEFAULT CASE

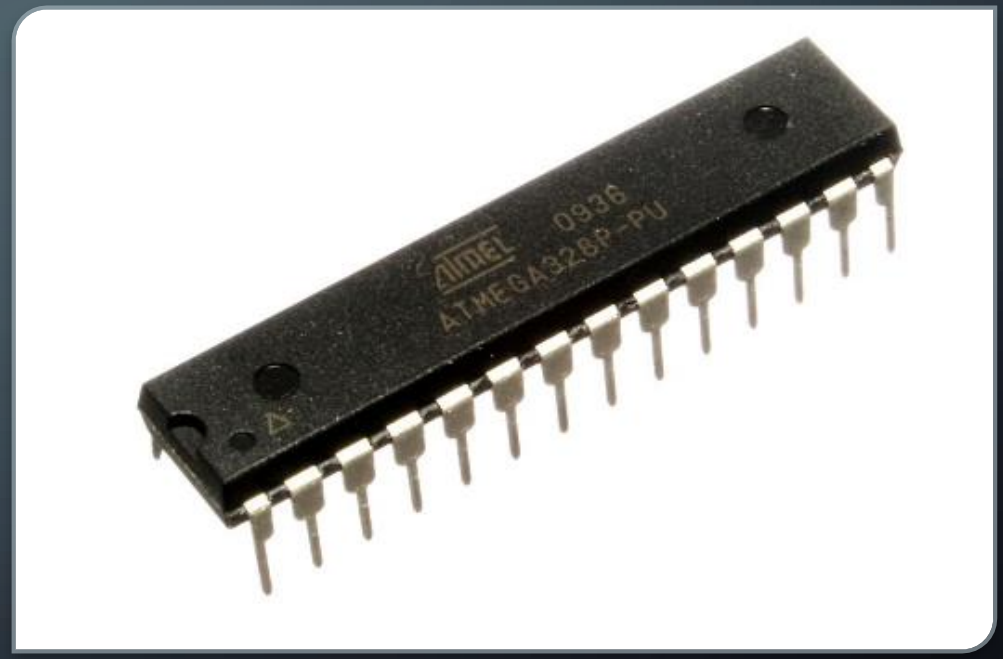




HARDWARE INTEGRATION

Microcontroller Selection

- ATMEGA328P
- Will act as the brain of the project
- Will control all the sensors along with communicating with NodeMCU for Alexa Commands

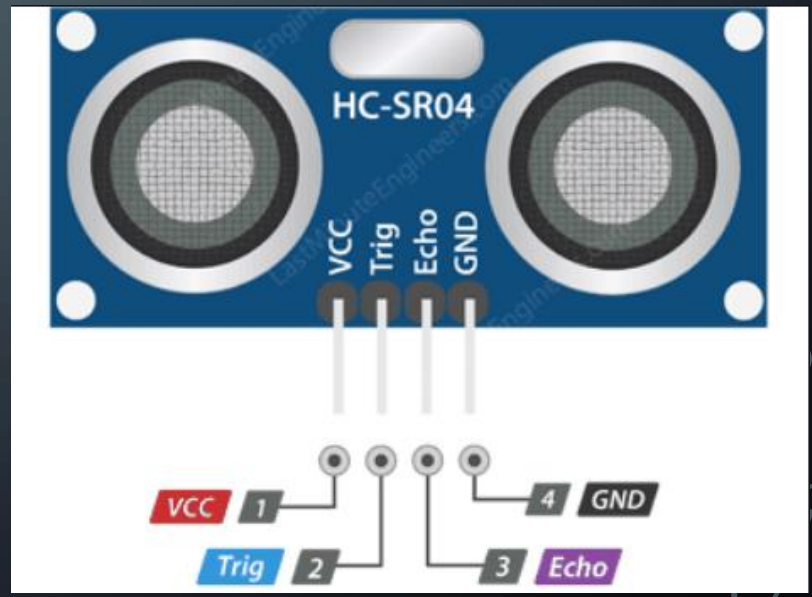


Feature	Specification
Operating Voltage	5V
Memory	32KB
Processing Speed	16MHz
GPIO Pins	23

Ultrasonic Sensor Selection

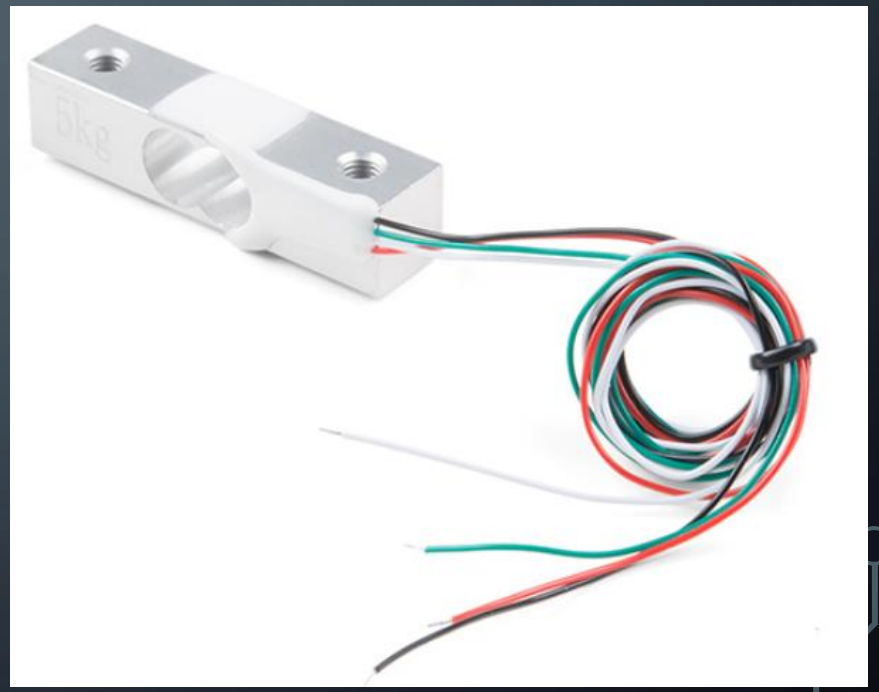
- HC-SR04
- Will act as a food reservoir sensor
- Will alert the user when food level is low and needs to be refilled

Feature	Specification
Operating Voltage	5V
Current Consumption	15mA
Min Range	2cm
Max Range	400cm
Cost	$3.95



Weight Sensor Selection

- Load Cell (wheat-stone bridge)
- A platform will be mounted on the load cell
- When the bowl reaches the user defined weight, the motor will stop spinning, thus not dispensing any more food



Feature	Specification
Operating Voltage	5V
Current Consumption	~2mA
Weight Range	0-5kg
Cost	$12.99 (includes amplifier)

Battery and Charger

Amp hours

Ah = Q = It

Q = 4A * 2mins * 14cycles

Q = (112 A*mins)/60mins

Q = Ah = 1.867Ah

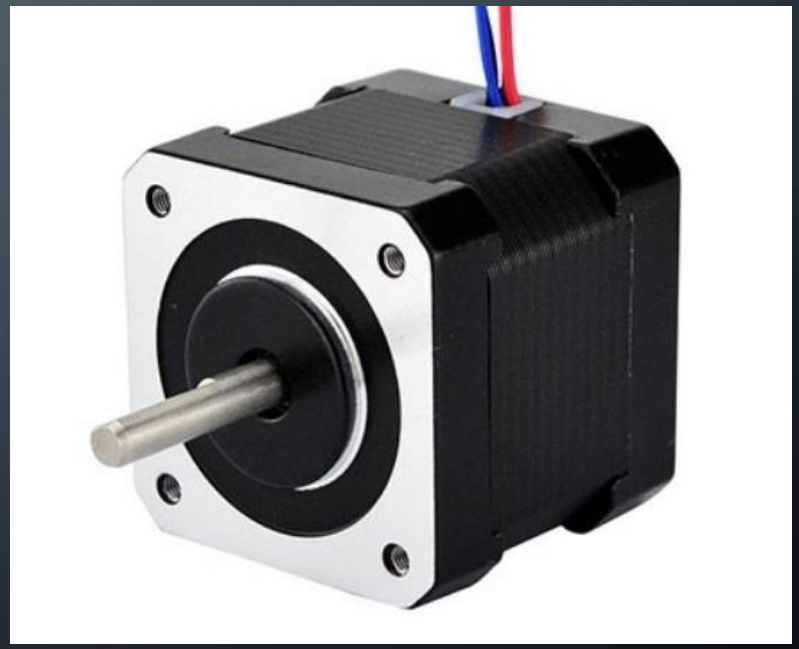
- 12V, 5Ah AGM/SLA battery
- Battery is spill proof, resistant to gas leaks, and shock resistant

- 12V, 750mA automatic battery charger
- Falls within the 20% battery charging rule
- Can be left plugged in, will not over charge the battery

Motor Selection

- Nema 17 Motor
- Will be attached to auger and listen to commands from the microcontroller/NodeMCU.
- The motor will be able to be turned on via Alexa command and stop once a set weight is reached.

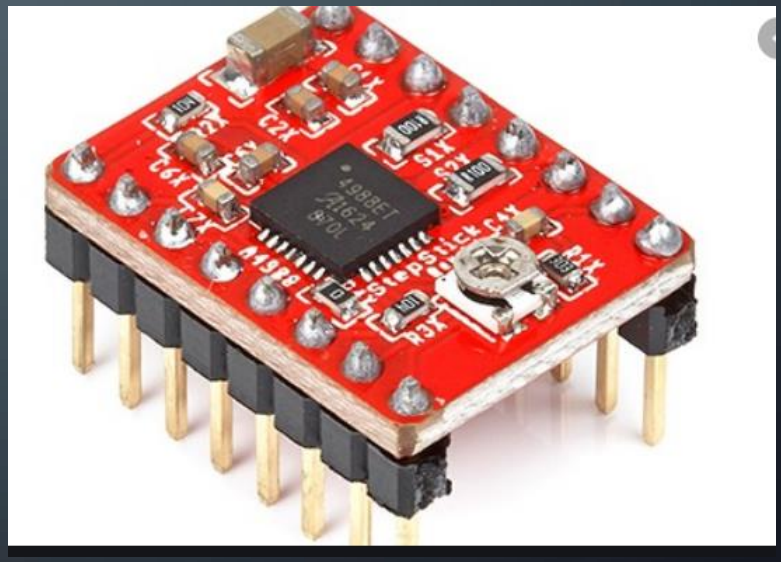
Feature	Specification
Operating Voltage	12V
Current	1.5A
Step Angle	1.8 degrees
Cost	~$10



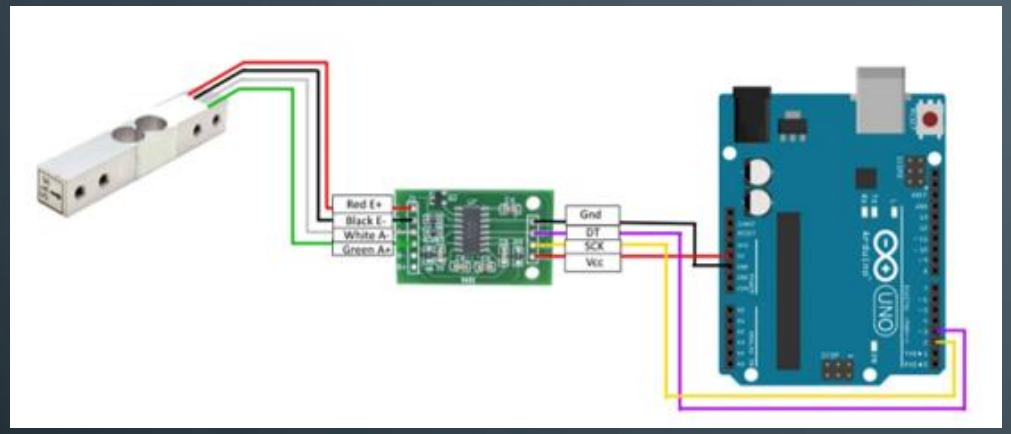
Motor Driver Selection

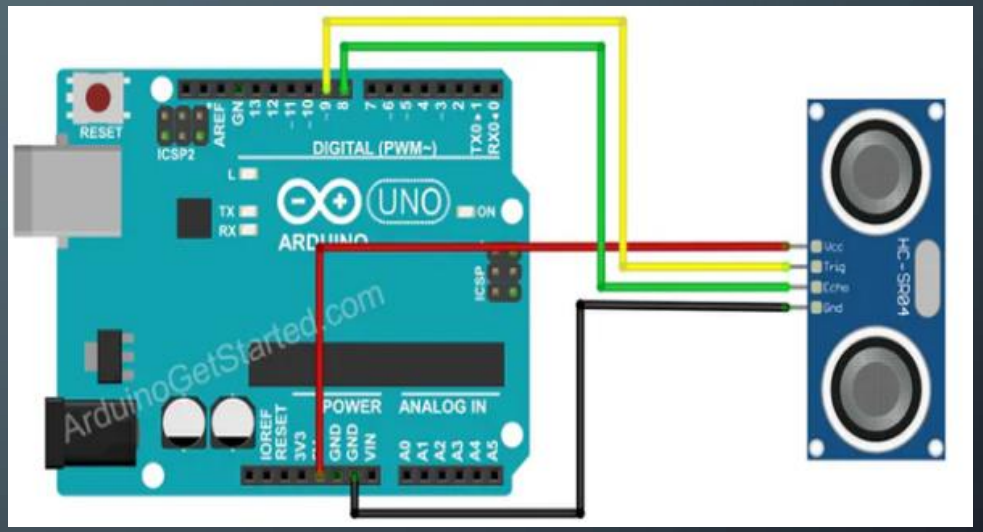
- A4988 Stepper Motor Driver
- Purpose is for adjustable current limiting.
- Over-current and over-temperature protection.

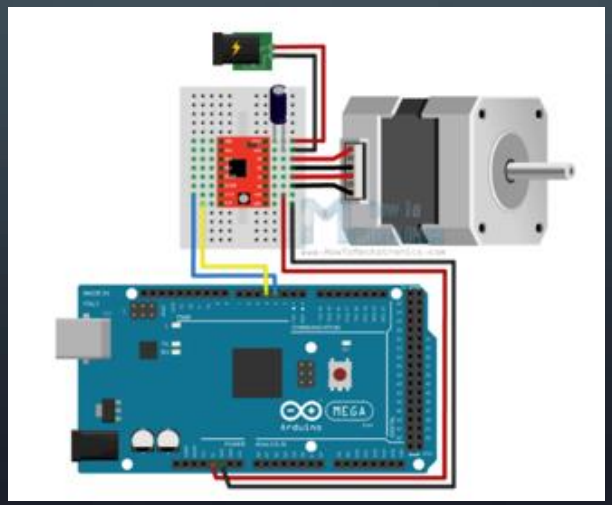
Feature	Specification
Logic Input Voltage	3.3V or 5V
Load Supply Voltage	8-35V
Max Output Current	2A
Cost	~$2

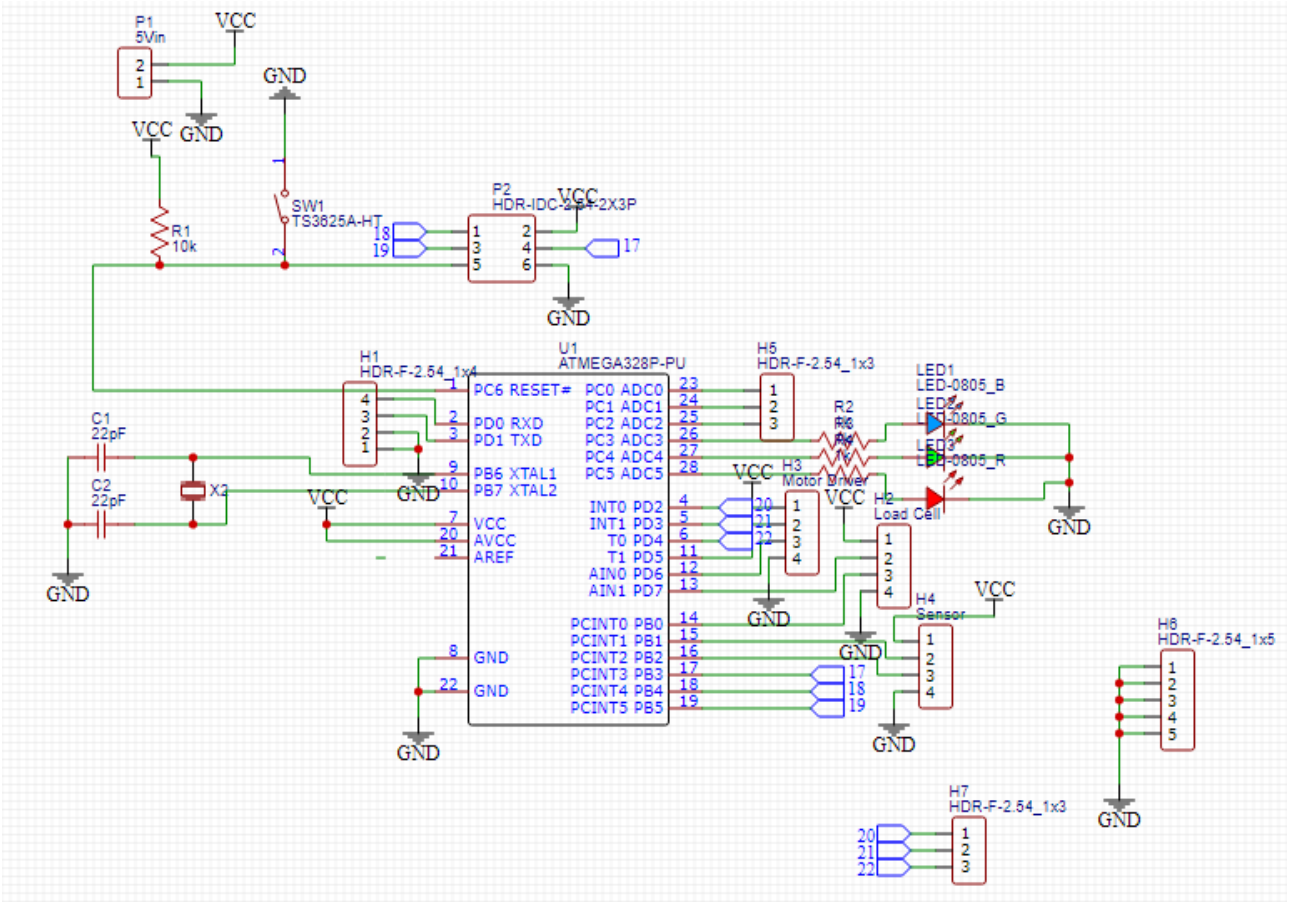


PROTYPING TESTING PLANS



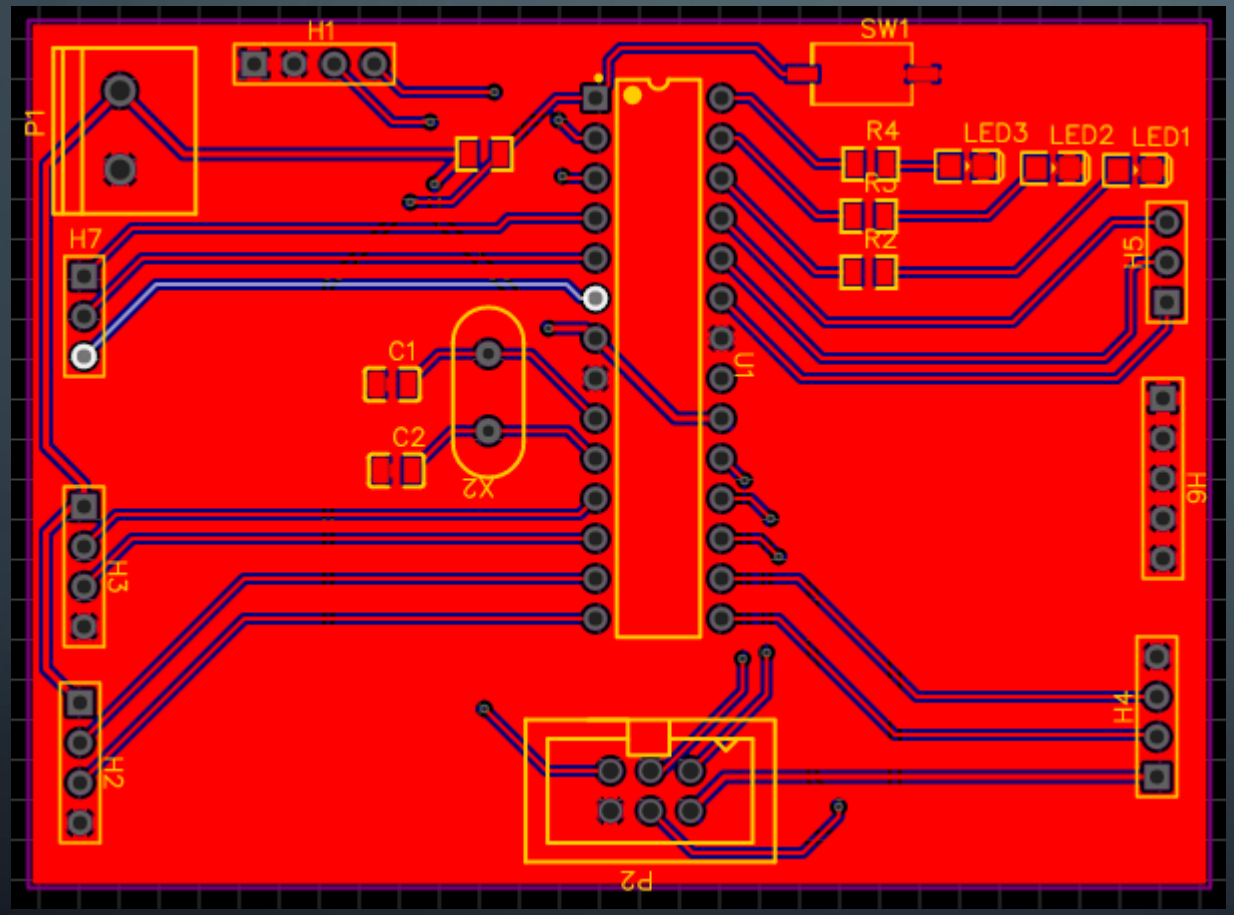






MAIN PCB SCHEMATIC

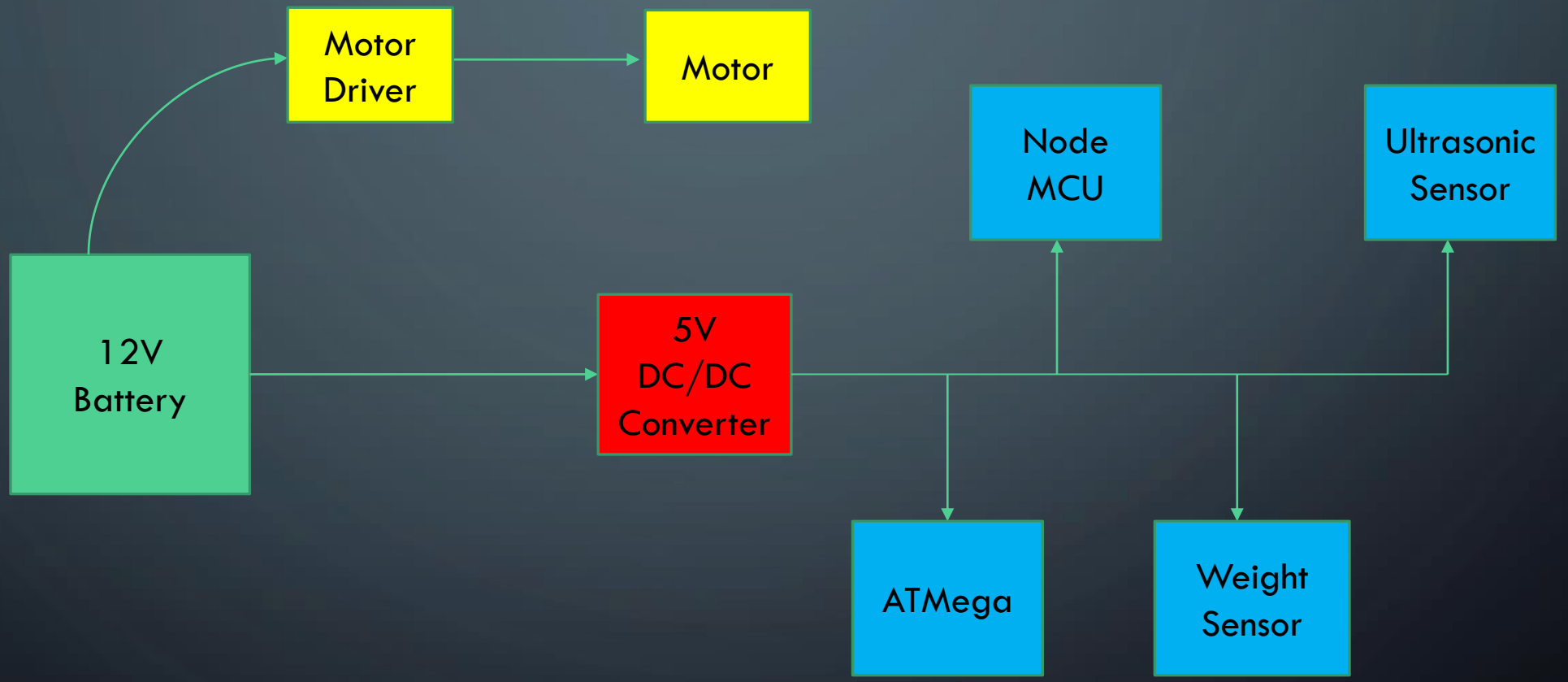
- Supporting parts (i.e 16MHz crystal).
- Pin headers for all peripherals.
- Three status LEDs that give the user feedback if needed.
- Reset button also included for debugging purposes.



MAIN PCB LAYOUT

- Board Size: 75mm x 55mm
- 2-layer, 1 oz copper design
- BOM Total: 17

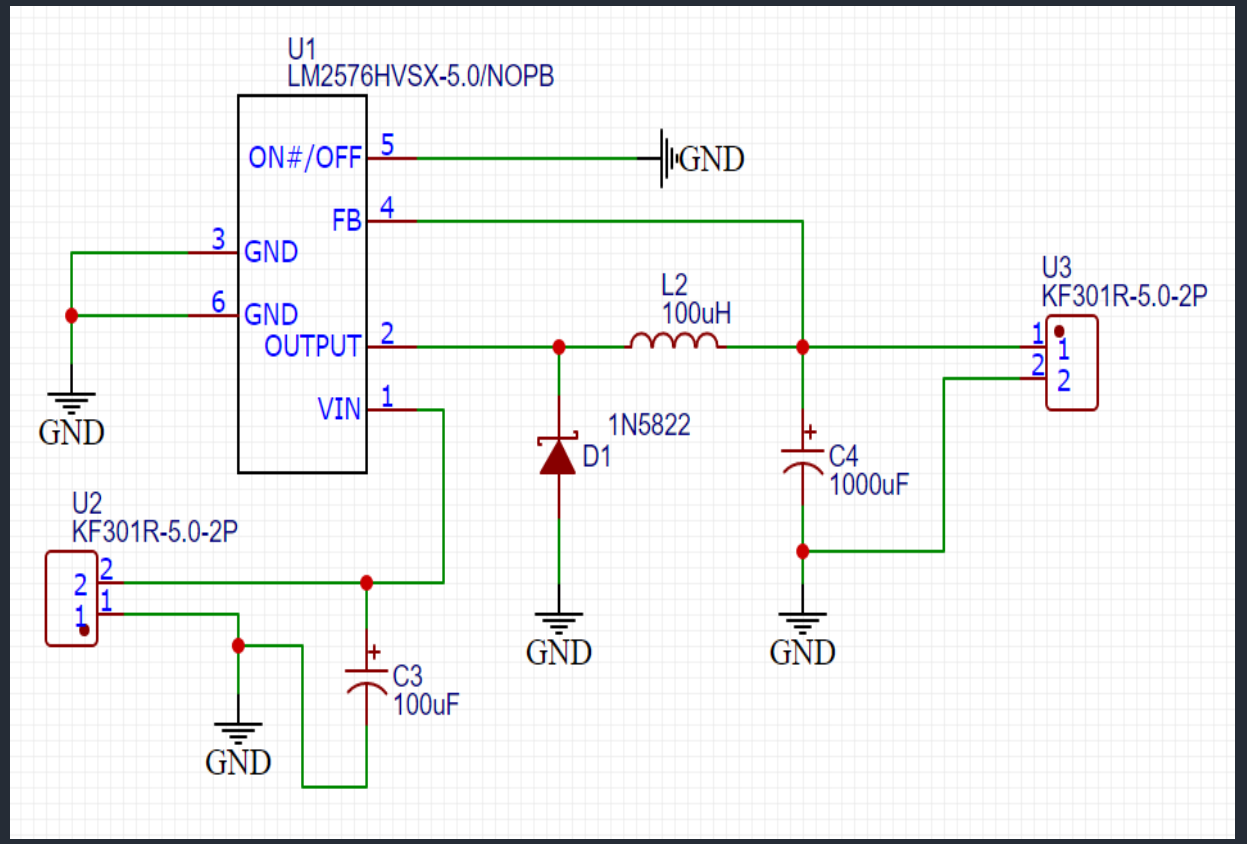
Power Distribution Block Diagram



DC/DC BUCK CONVERTER

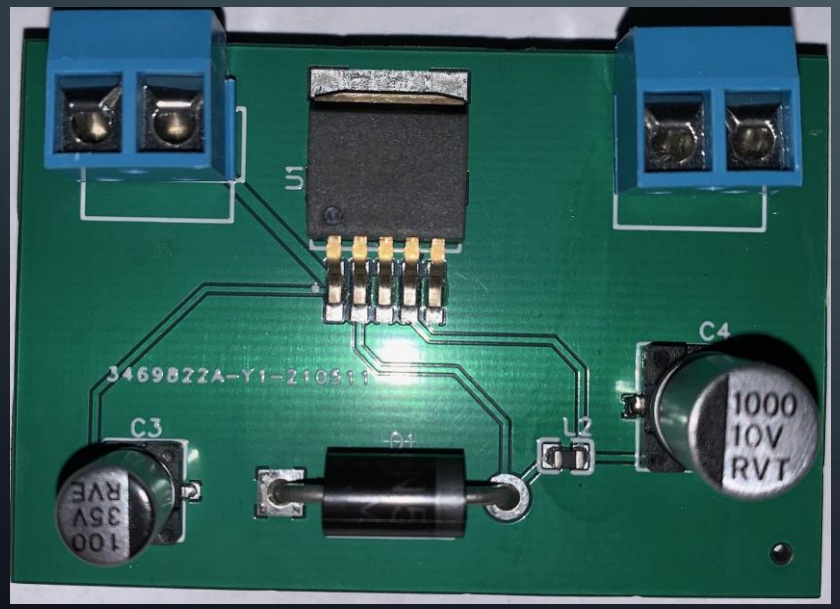
- LM2576HV
- Switching Regulator
- Input voltage range of 4V-60V
- Capable of driving 3A load with good load regulation
- High efficiency
- Low number of components required

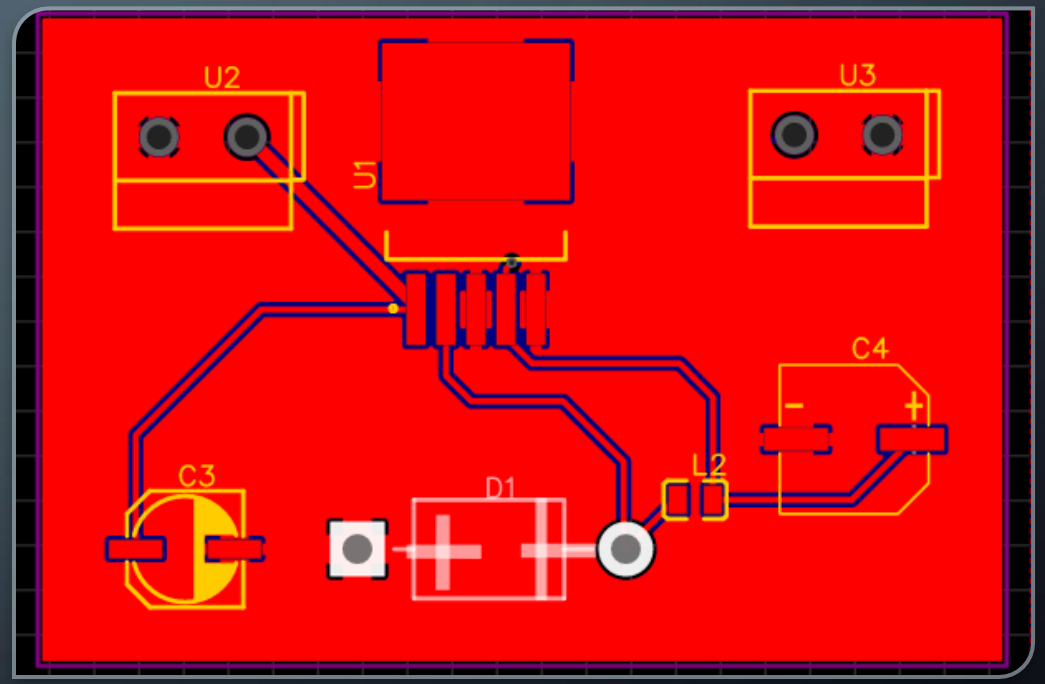
DC/DC CONVERTER SCHEMATIC



DC/DC BOARD LAYOUT

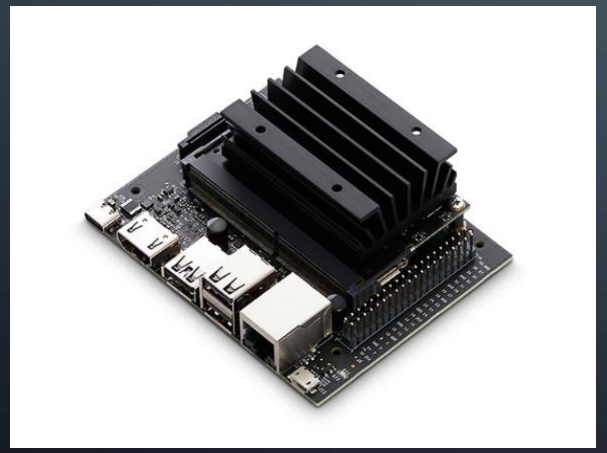
- Board Size: 55mm x 37mm
- 2-layer, 1 oz copper design
- BOM Total: 7



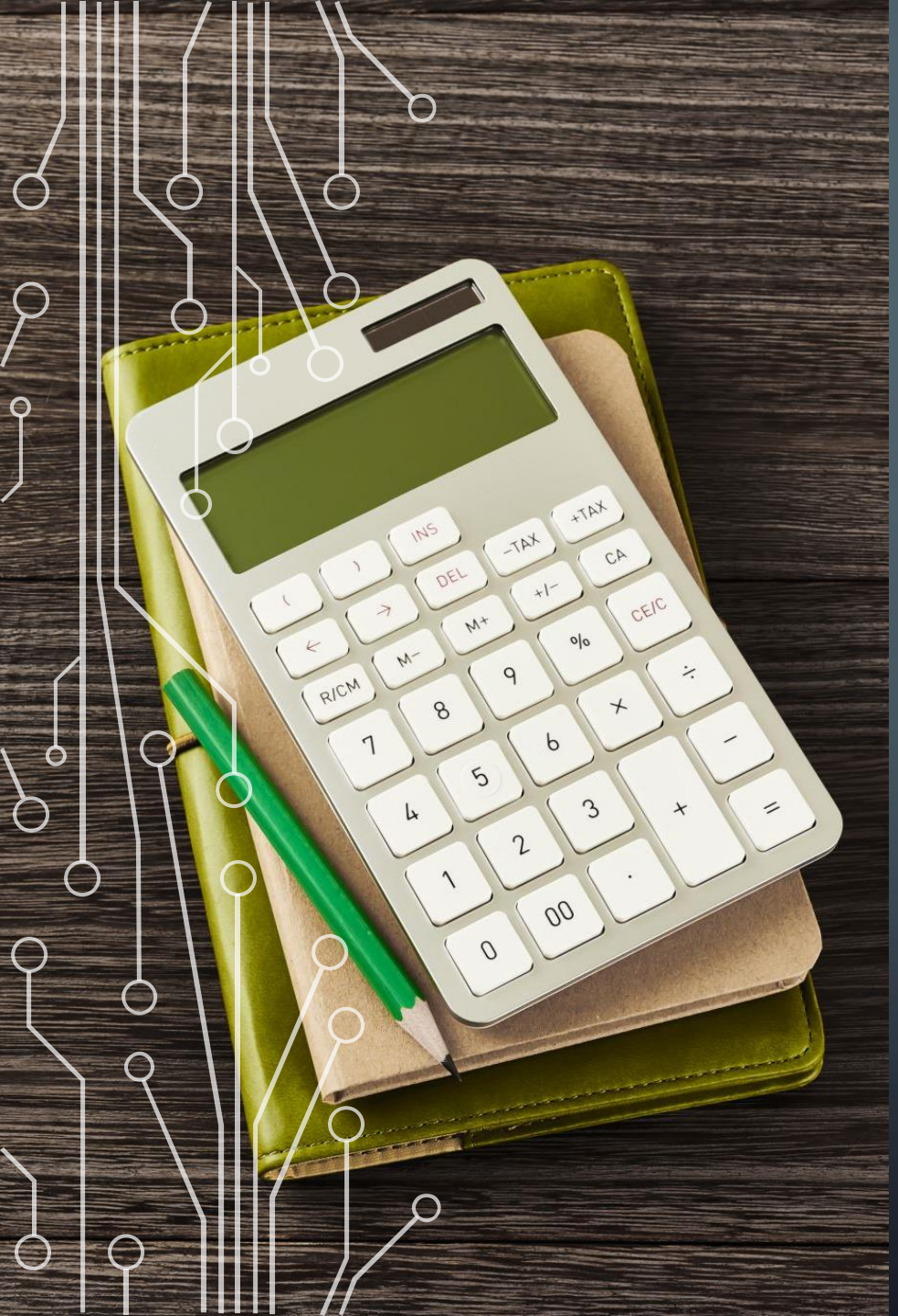


STRETCH GOALS

- Computer Vision with Jetson Nano
- If time and budget allows, computer vision will be added to the project.



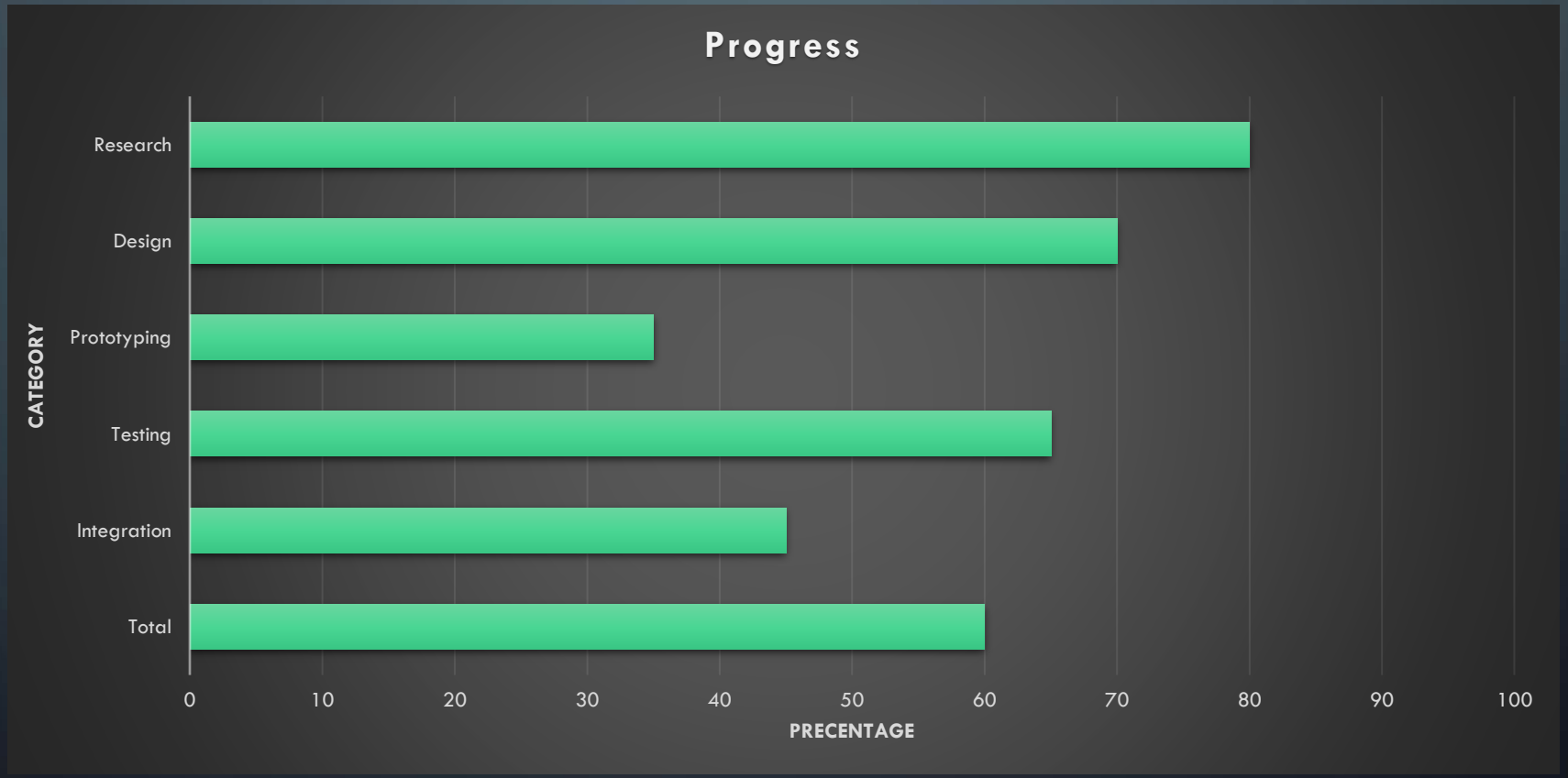
ADMINISTRATIVE CONTENT



Budget

Item	Cost
Weight sensing module	$12.99
NVIDIA Jetson Nano 2GB	$63.13
Arduino Uno R3 x 2	$37.87
DC/DC PCB	$39.11
Proto PCB #1	$45.11
Miscellaneous Matrials	$30
Auger	$10
Jumper Wires	$6.00
BJTs & Resistor Kit	$21.00
Battery	$15.60
Battery Charger	$17.98
Motor	$19.69
Motor Drivers (5)	$8.00
Ultrasonic Sensors (2)	$9
Node MCU (2)	$8
Chip puller	$3.34
PVC Pipe	$4
Housing mats (wood, glue, screws, finish	TBD
Total	$350.82

Progress


Progress
Research
Design
Prototyping
Testing
Integration
Total
CATEGORY
0
10
20
30
40
50
60
70
80
90
100
PRECENTAGE

Work Distribution

	Cameron Nero	Jacob Paul	Liam Tsoi	Carlos Lairet
Alexa Integration			Secondary	Primary
MCU Integration			Primary	Secondary
PCB Design	Primary	Secondary		
Power Design	Secondary	Primary		
Hardware Integration	Primary	Primary		
Computer Vision(Stretch)			Primary	Primary

Challenges

- Low Budget, since it is funded by the group.
- Mechanical Design.
- Time
- Parts/Tools Availability

QUESTIONS?