System Overview

The “Bird Brain” is a smart chicken coop system which continuously tracks environment variables to provide warnings, telemetric data and automation of some tasks to assist the caretakers of the chickens. The system includes food and water tracking via ultrasonic distance sensors, daylight and temperature sensing via external probes, a warning light tower to indicate issues, an automated door assembly, a heat lamp with sunset-emulating dimmer, and a wireless communication module for data logging and visualization.

Electrical Specifications

Power Requirements	**Minimum current rating**
5V DC	200mA
12V DC	1A
24V DC	2.5A
120V AC	3A

Recommended Temperature Range

Minium	Maximum
-25℃ (-13℉)	70℃ (158℉)

Setup and Operation

Installation:

1. Vertically mount the main enclosure in a central location with access to power, and preferably close to the food and water dispensers.
2. Mount the door motor directly above the door and attach with shaft coupling.
3. Screw the food and water sensors onto the inside of their respective container’s end caps. Seal any holes created by the screws with silicone sealant.
4. Attach the water temperature probe to the outside of the water container. Remove the cap from the food container and place the food level disc on top of the food.
5. Mount the daylight sensor to face through a sunny external window. Alternatively, drill a hole through the ceiling or an external wall and mount the sensor in the opening.

6. Clamp the heat lamp on a ceiling beam or hang from a chain. Clip the malfunction detector near the light bulb.
7. Mount the warning light tower in an accessible and visible location.
8. Use included waterproof connectors to connect all components to their respective locations on the main boards in the enclosure. Consult the wiring schematic for additional details.
9. Securely fasten the enclosure lid. Connect the power supplies to the outdoor power strip and activate the switch.
10. Allow the system approximate 10 seconds to start up. Some or all of the warning lights may illuminate during this time. This is normal.
11. Use a phone or computer to connect to the cloud data webpage. Verify the reported sensor readings are accurate.

Operation Info:

- The warning lights provide key information about the coop's status at a quick glance. A red light indicates a near-freezing temperature or failure of the heat lamp, yellow indicates a low food and/or water level, and green indicates no detected issue. The light will automatically return to green when the issue is resolved.
- When refilling the food container, the food level disc must first be removed from the container and placed back on top after it is filled. The food should also be manually spread so that it is flat. Failure to do so may result in inaccurate or unreliable sensor readings.
- The times which the door opens, the light turns, the wireless network connection, and many other behaviors can be configured in the provided source code files.

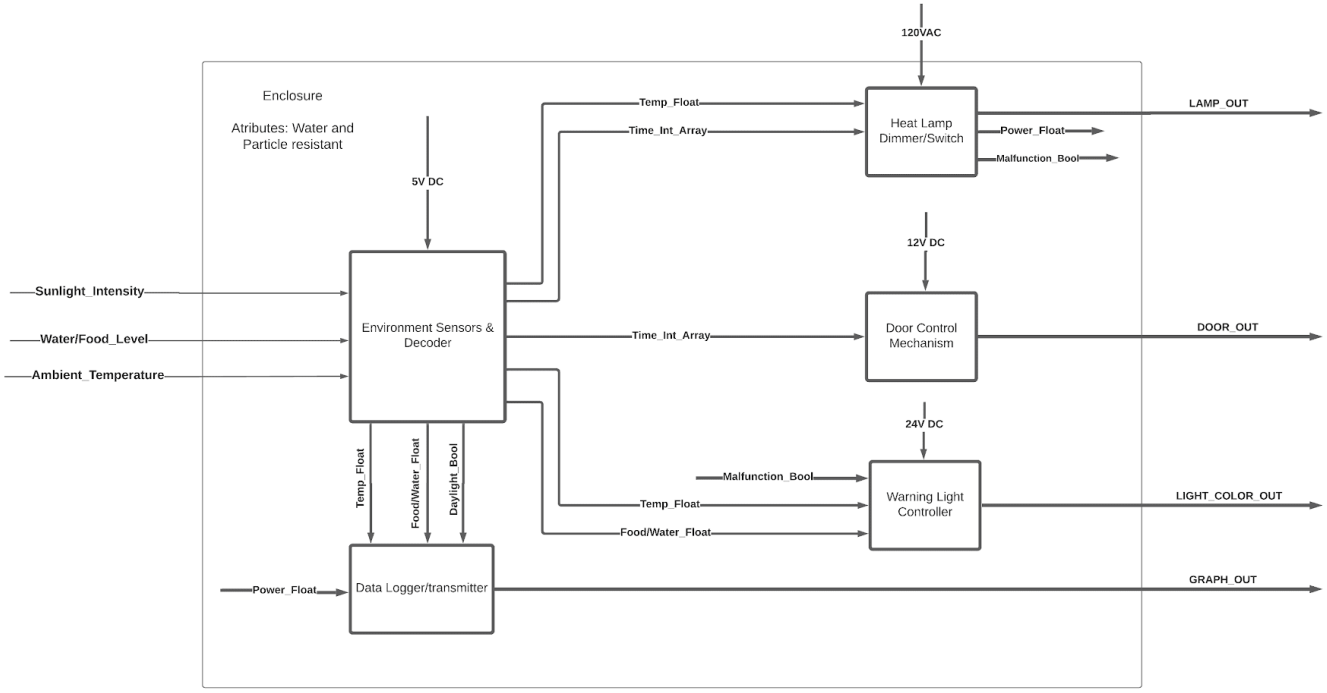
PCB Information

The PCB serves to interface the environment sensors with the microcontroller. Its size is 70mm x 60mm and is designed to fit within its custom enclosure. The microcontroller interface sits on the left end of the board, while the right side contains the connectors for the sensors. The clock module is located in the center of the board.

Photo of fully connected PCB in its enclosure with lid removed.

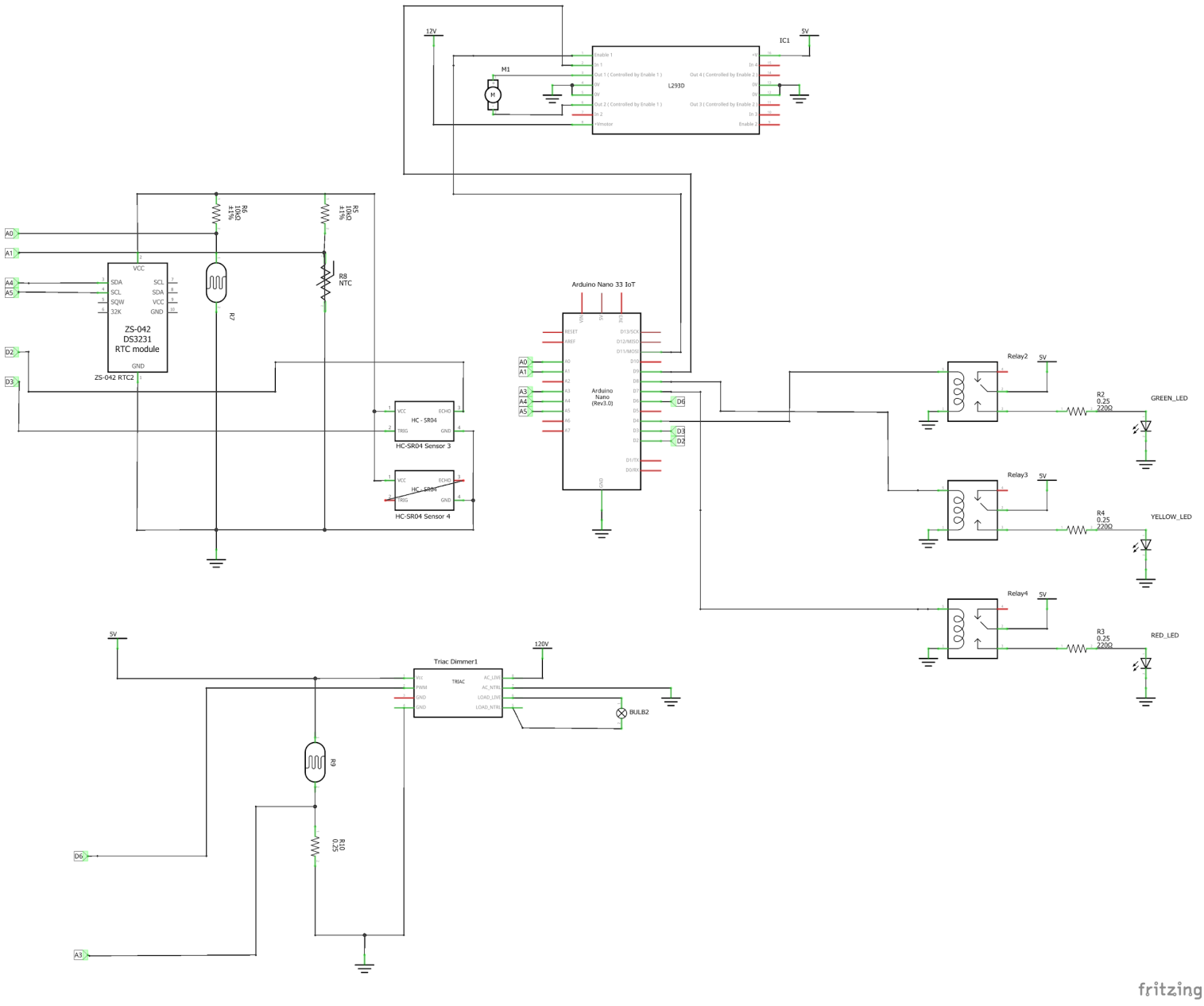
Block Diagram

The block diagram shows each module of the system and how they interface with each other. The environment sensors and decoder receives inputs from the food, water, sunlight and temperature sensors and converts them into their proper values. It also contains the RTC module for tracking time. The heat lamp dimmer takes the temperature and time inputs to control the heat lamp and its brightness depending on the time of day and if the temperature is freezing. The door controller provides power to a motor which opens or closes the door depending on the time of day. The warning light controller uses the sensor values and set thresholds to determine if any warning lights need to be active. The data logger sends the sensor data over Wi-Fi to store in the cloud. The enclosure containers the PCB sensor interface board along with the other boards to protect them from dust and moisture.



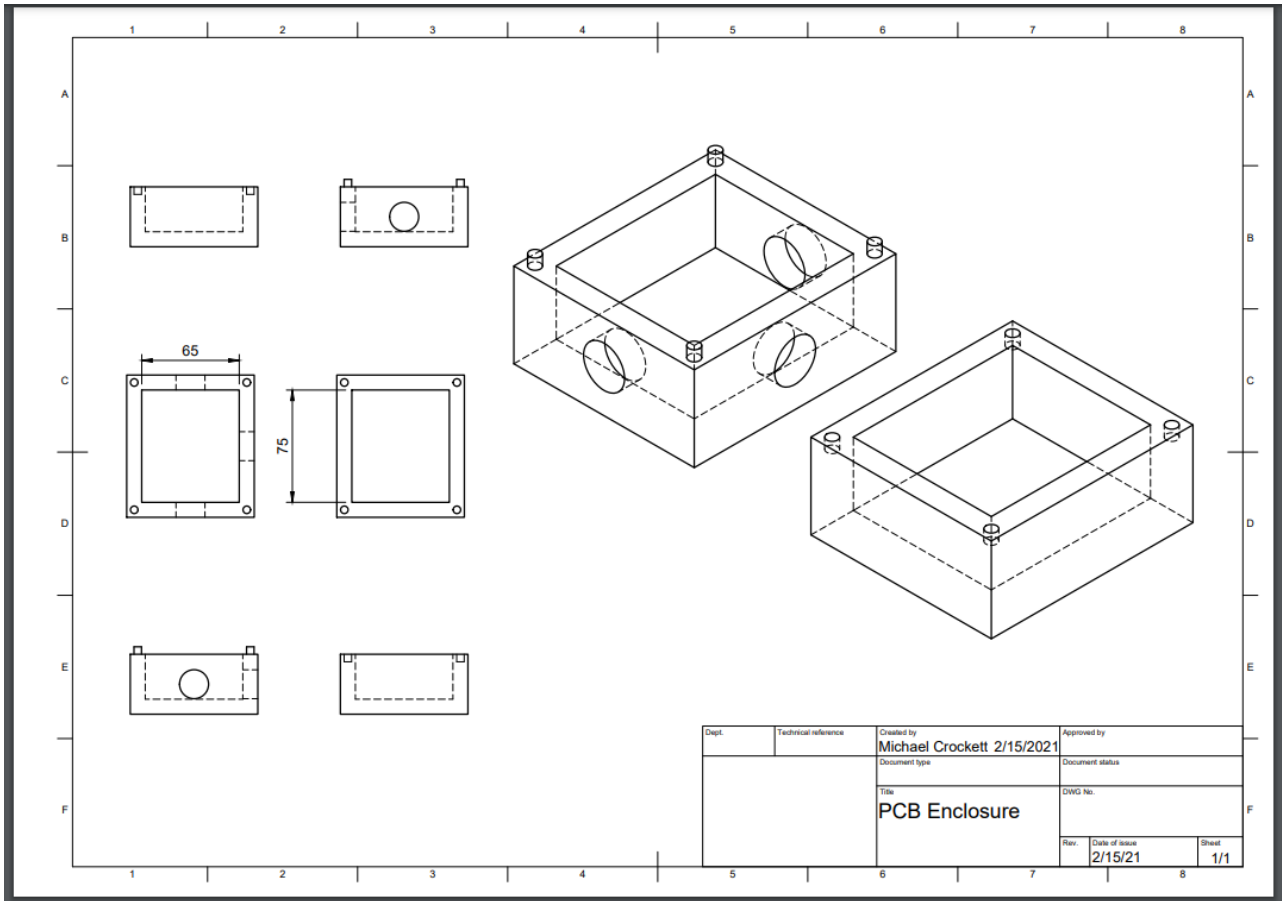
Schematic Diagram

The schematic shows how all components are electrically connected and which pins they occupy on the microcontroller. It is recommended that a 5V power supply separate from the microcontroller's own internal source is used due to the number of components which rely on the source. It is also recommended for future revisions that all non-external components (ie. sensors) are placed on a single PCB to reduce wire complexity and to potentially reduce noise and improve accuracy.



Enclosure Diagram

The enclosure diagram shows the PCB from several angles. It shows all of the holes and pegs that are used to secure it closed. The base dimensions for the PCB were used so that it would be a proper fit. The larger holes are used for input and output wires going to the PCB. If this project were done again the number of wire holes would be reduced to two as the third hole was not necessary.



Part Information

Part Name	Quantity	Price (approximate)
Data Transmission System		
Arduino Nano 33 IoT	1	$18
Automated Door Mechanism		
Motor	1	$8
Door	1	-
L293 H-bridge	1	$4
Environment Sensors		

Thermistor	1	$1
RTC (Time) Module	1	$2.20
Ultrasonic sensor	2	$6
Photoresistor	1	$2
1/4W or 1/8W 10k THT resistor	2	$0.1
PCB	1	$4
Warning Lights Block		
Through Hole LEDs	1	$7.25
2 Channel Relays	2	$3
220 Ohm Resistors	4	$1
PCB Enclosure		
3D Printed Model	1	-
Lamp Dimmer Block		
Photoresistor	1	$2
AC Triac dimmer board	1	$24
1/4W or 1/8W 10k THT resistor	2	$0.1