Embedded Project Report:
Automated Pet Feeder

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Introduction:

In this report, we will analyze the overall construction and implementation of an automated pet feeder given limited resources. As noted in previous documentation, this device is by no means a final product, rather more a test of principal in where engineering concepts are applied in a systematic way to produce a final result. To gain a better understanding of the overall process of constructing the pet feeder, it is imperative that the goals of this project are set clear. For starters, one of the main objectives of this project is for the autonomous operations of feeding the pet. In other words, the pet feeder should know when to feed the pet, for how long, and at what power should the motors run. Furthermore, to better assist in providing adequate nutrition to the pet, the device should be able to approximate the water level within the bowl. In so, it can refill when deemed most appropriate. Lastly, it is evident that the device will run out of food supplies given a certain amount of time. Thus, the device should be able to visually and audibly communicate to the owner when maintenance is needed. Now that we have set clear the goals of this project, we can overlay a general plan of construction for this device. Before any software can be written for this device, the hardware components should be implemented first to facilitate the harmonization of the components in future construction. Once the hardware is in perfect working order, enabling the device to read the capacitance from the water bowl as a measurement of volume is a must. After establishing a reliable system for volume measurement, creating a scheduler in which we can program to activate the device during certain feeding events will follow consequently. Lastly, enabling the device to function in different water modes depending on the purpose of the owner will help maintain a constant water level. Given our outline of the design is defined, all that is needed is the construction of the device itself.

Theory of Operation:

The final product should operate in the following ways:

- Given a specific alarm, the device should dispense the food at a certain time for a specific period of time. Once the food has been dispensed, the device should look for the next feeding event.
- Based on a certain amount of water in the bowl, the device should dispense water to maintain the volume up to a desired level and above a minimum level.
- Alert the owner when the volume in the bowl is below a certain level, in which the owner must check for water maintenance within the device.
- The motors should be completely automated, no human intervention besides a steady power supply should be used.

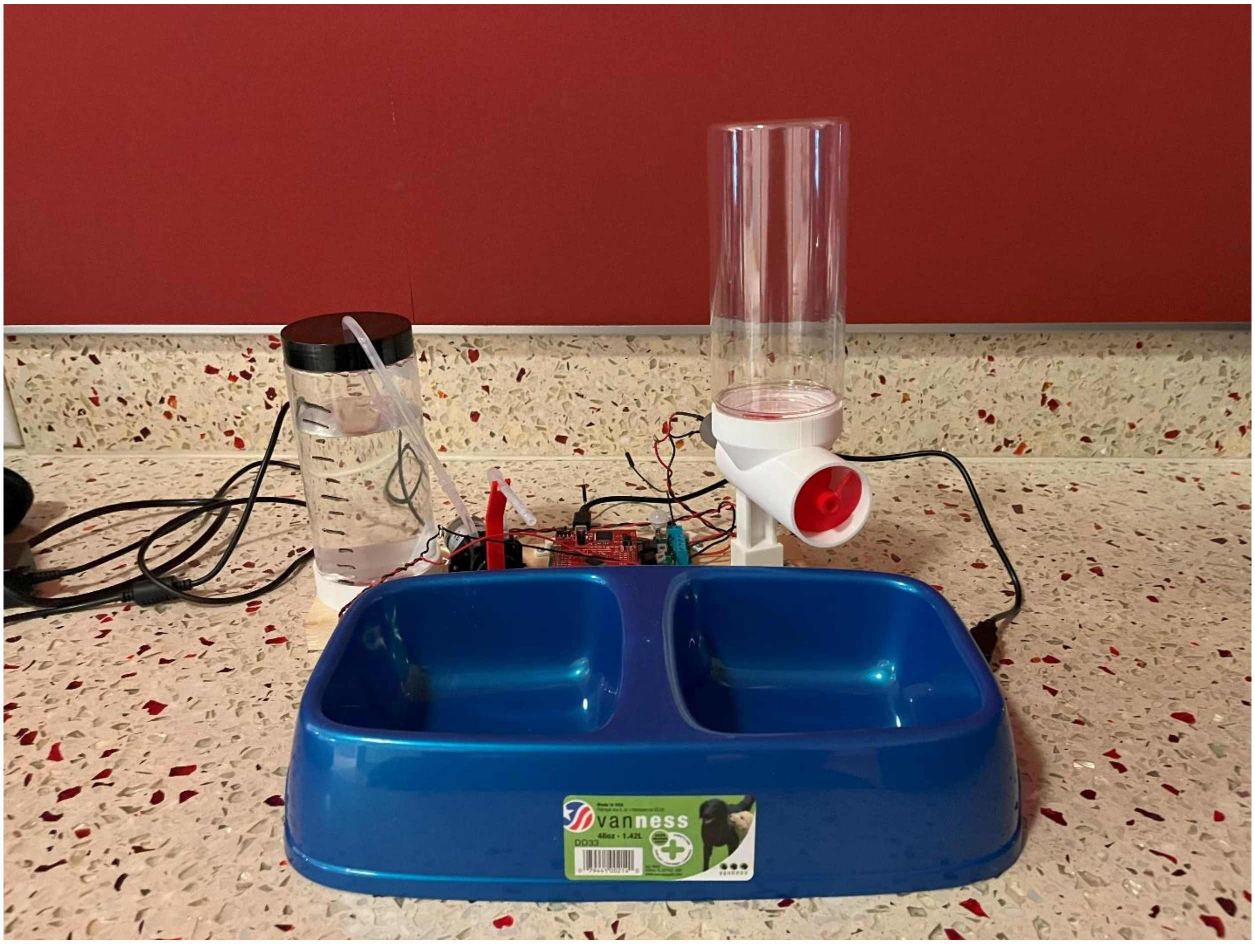
For the device to store the feeding times set by the user, we must take advantage of the TI Board’s EPROM 256 Kb of storage, which is available for our use. To store such information, we must write an interface in which we can program the EPROM to store the parameters for each feeding event. Once done, we use the Real Time Clock register to keep count of our current time. Furthermore, we can use the clock’s match functionality to create an interrupt when our alarm value is equivalent to our current time. In so, that interrupt enables the motors to run. Moreover, to determine the volume within the bowl, we can construct a simple capacitor using the water as a charged plate. Thus, when the volume of the water increases, the volume should increase in a linear behavior. To perform such action, we will compare the amount of time it takes the capacitor to charge to a certain reference voltage. Once we reach the reference, we take the amount of time and convert it to an approximate amount of volume. From there, we can take that approximate volume to decide whether water needs to be filled or not. However, if our water approximation is below the minimum threshold, we will sound the alarm by driving that certain pin to 3.3V and 0V at a certain rate. Lastly, we must configure the circuit so that all is controlled by the TI Board, so all components must connect with the GPIOS of the board.

Observations:

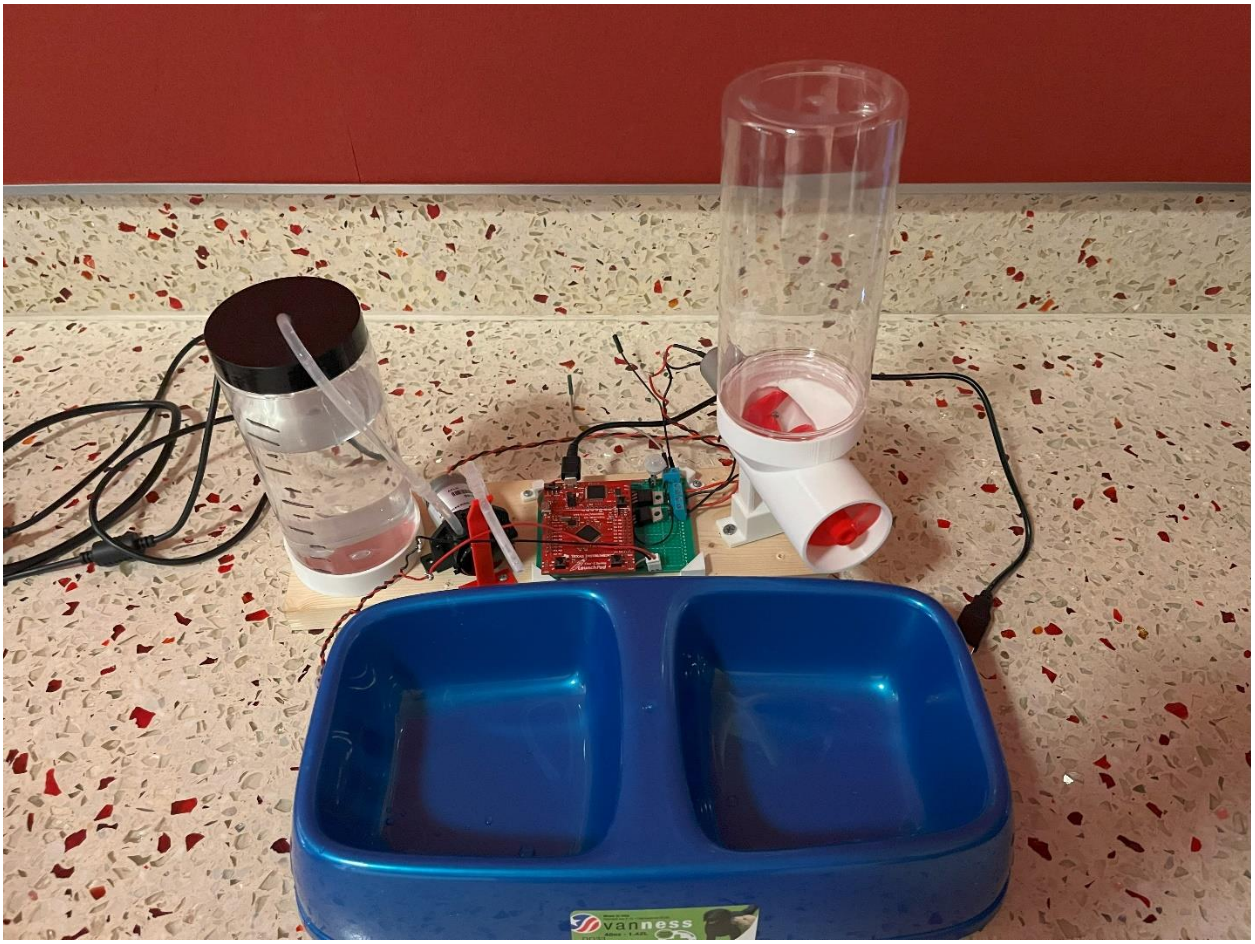
During the construction of this device, we encountered some problems with the functionality and accuracy of the device. For starters, during the wiring of the mechanical components, there was many issues with the components of the circuit being deprived of the voltage needed to perform its operations. After analyzing the circuit on the green board, it was discovered that poor soldering skills caused inefficient power transmission to their respective components. Furthermore, during the construction of the water bowl, there was immense interference with our capacitor bowl due to electromagnetic interference. Thus, to avoid as much interference as possible, operations of this device was used outside the laboratory. Lastly, when configuring the Real Time Clock on the TI Board, values set to the registers within the Hibernation module would be ignored. Due to this, our configuration of the following modules would falter and lead to unexpected results. Therefore, we wrote code to wait for the Hibernation WC bit to be high before writing to any of the registers.

Conclusions:

In conclusion, the device worked according to our specifications with a few minor errors within our device. Although the construction of this device did come with a few obstacles along the timeline, the device did perform better than expected. However, it should be noted that results did vary with a substantial range during the construction of the device. Even so, this was a valuable learning experience in which we were able to apply the fundamental concepts of engineering to our design. Thus, creating a successful device that can be further developed into a fully fledge operational product when enough resources are invested into it.



Device Completion : 12/5/2023



Device Completion : 12/5/2023