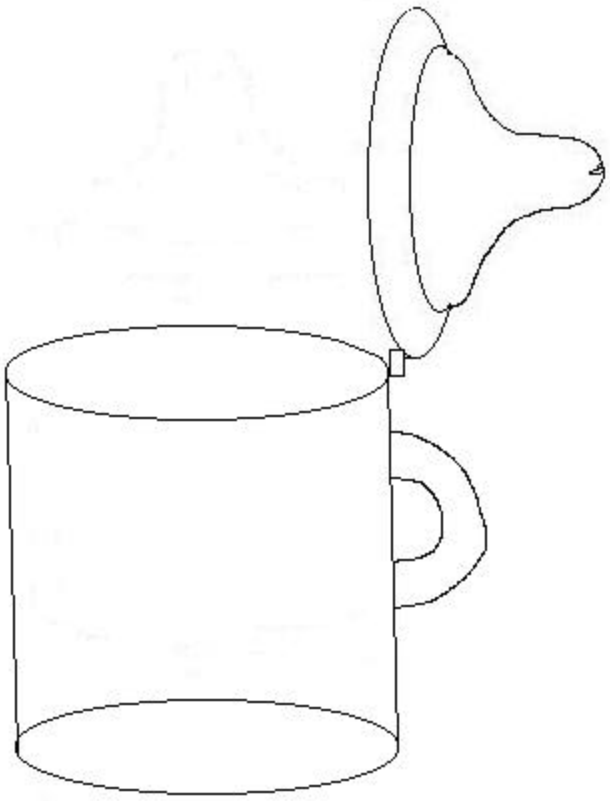
Cup/Bottle to Limit Swallowing Volume



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Problem Statement:

In the radiological evaluation of swallowing in pediatric patients, as well as in therapy, higher volumes of liquid lead to a higher likelihood of aspiration. A cup and/or bottle designed that could restrict the amount of liquid given to a patient would alleviate this problem. The goal is to be able to "set" a cup and or bottle to a bolus size that would reduce the occurrence and or severity of aspiration during therapy. It is of interest to have the device compatible for both a bottle and cup so that it could be used with several ages.

Background Information:

Most of the information that we have concerning the design problem came directly from the client. Basically, children that have swallowing disorders, usually caused by incorrectly formed tissues in the epiglottis or from lack of ability to use correct technique, tend to aspirate when they swallow. This means that liquid goes down the wrong way and ends up in the lungs instead of on route to the stomach. It has been shown by professionals in the field, using radiological evaluation, that if a smaller amount of liquid is delivered during each swallow that aspiration is far less likely and severe. So what they would like to have designed is a device that is to be used by children that will limit the size of bolus, or swallow volume. The user should be able to set or measure the amount of fluid being delivered to within 1 cubic centimeter. It should be light enough to be lifted by a child, hold approximately eight ounces, and it wouldn't hurt to be nice looking. (For Specifications see Appendix A) There are some competing designs already out there, however most do not measure delivered volume accurately, are heavy, and not attractive to children. The client has already seen a few such designs and wishes for us to come up with something better.

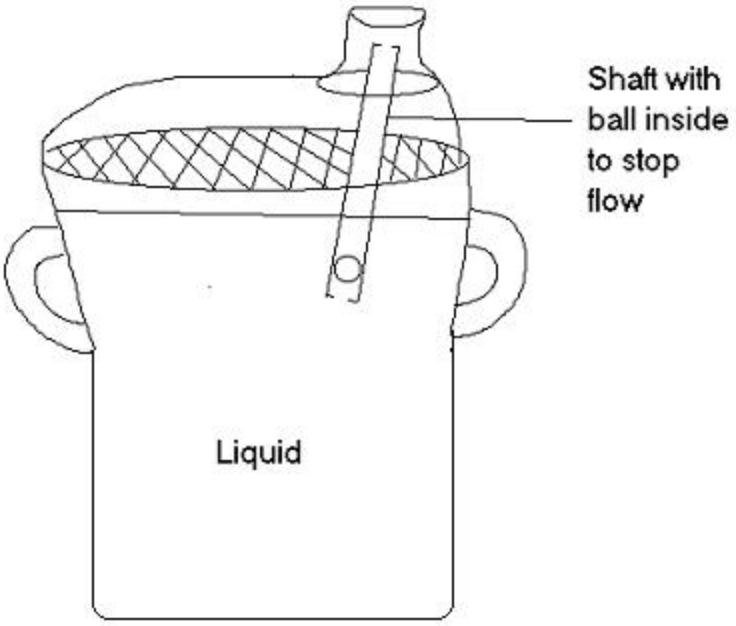
Alternative Solutions:

We have come up with three different designs as possible solutions to the problem. They are The Limited Sippy, The Super Bottle, and The Manual Pressure Cup. The Limited Sippy is best suited as a cup design rather then a bottle. That is because it must be tipped each time a new amount of liquid is to be released, which works best as a sippy cup. The Super Bottle is the most advanced and probably the most expensive

design. It includes the use of a microprocessor to deliver a set amount of liquid every set amount of time. It could be hooked up to a PC for the inputs to be set. The Manual Pressure Cup is a simple yet versatile design. It makes use of a syringe-like system that receives pressure from the user to transport fluid from a holding chamber to a delivering chamber so that a user defined amount of liquid can be delivered each time. The design is capable of incorporating all three of the mouthpieces that have been suggested by the client, a pacifier, a nipple, and a cup mouthpiece.

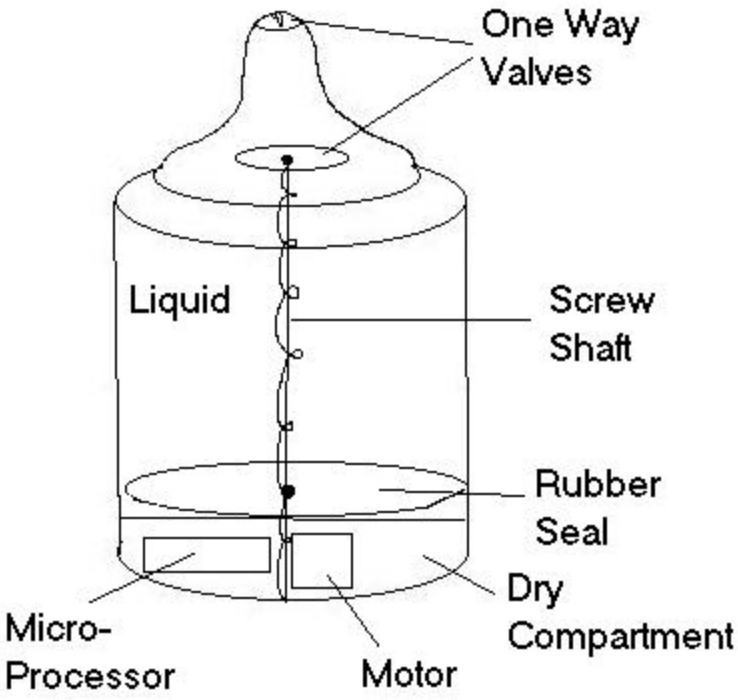
The Limited Sippy:

The Limited Sippy design is a very simple design that is easily applied to spill proof cups that children currently use to learn to drink from, called sippy cups. It consists of a sippy cup that has a cover on the cup portion separating the liquid from the lid formed for drinking. There is a hollow tube or shaft that slides through the cover into the liquid chamber; this needs to be a waterproof seal. Inside the shaft is a ball that can't get out of either end. When the cup is held upright the ball naturally rests at the bottom of the shaft. When the cup is tipped upside-down to drink from, the ball slides with the liquid toward the mouth of the cup. Once the ball reaches the top of the shaft it is pressed tight, creating a seal. The length of the shaft could adjust the amount of liquid delivered during each drink. The advantages of this design include ease of use, low cost of manufacturing, and durability. Some disadvantages are that is best applied to a sippy cup and not as good for a bottle, and there are some details to be worked out concerning how level of liquid remaining in the cup relates to the amount of liquid delivered.



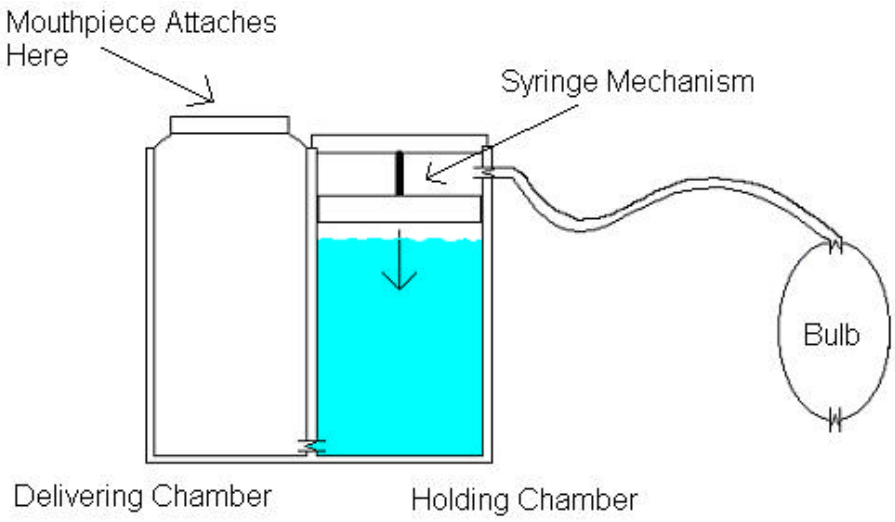
The Super Bottle:

The Super Bottle design is a more complicated design that could be applied to either a cup or a bottle. It consists of a bottle with a shaft down the middle with screw shape to it that goes through a rubber seal that is at the bottom of the liquid chamber. The screw can be controlled by a small motor that is connected to a microprocessor. When the microprocessor tells the motor to run, it turns the screw, which causes the rubber seal to push toward the nipple and forces water through the one-way valves. There are two one-way valves near the top to make the bottle useable by children with cleft palate who can't provide enough suction to get liquid out of a nipple. If a technique is used that I call "loading the line" with these one-way valves this problem should be taken care of. To "load the line" the nipple should be filled with liquid before the child tries to drink from the bottle. That way when liquid is forced through the first valve by the rubber seal, liquid will automatically be forced through the second one-way valve and all the way out of the nipple. In this way the child will not have to apply any suction in order to drink. The microprocessor makes the design very versatile. By plugging the microprocessor into a PC, a user could input values such as amount of liquid to be delivered, every so many seconds, volume of liquid put into bottle, etc. This way it could be determined how many turns of the motor equal a certain amount of cubic centimeters and the bottle could be set and them work completely on its own until the liquid is gone. The advantages of this design are its incredible diversity, ease of use for child, and accuracy. Some possible disadvantages of this design include cost, weight, and reliance on computers. However, weight may be found to be acceptable depending on how small and light of a microprocessor can be found.



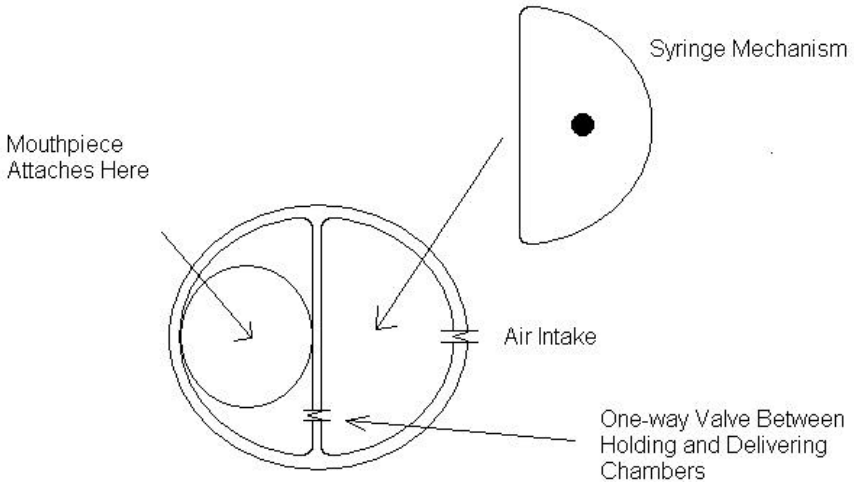
The Manual Pressure Cup:

This design seems to be the simplest, most cost effective idea that we have put together. Trying to implicate a broad range of users and uses, this design was created to come with three different parts—with each part working together to dispense an amount of liquid to a child. The three parts include a cup that holds and delivers liquid (2 chambers—holding and delivering), a device used to force liquid from one chamber to the other, and a desirable mouthpiece that can attach to the cup. This system uses a holding chamber that can transport a certain amount of liquid to the delivering chamber. After the holding chamber is filled to the users satisfaction, the liquid in it can be forced into the delivering chamber. A syringe type mechanism that attaches onto the holding chamber makes this possible. Here is a simple schematic to portray the design.



1. Side View

Attaching to the syringe mechanism is a hose and bulb designed to force air in between the top of the holding chamber and the syringe. The syringe is attached to the top of the holding chamber by an extending metal structure that acts like an antenna using a series of metals of different diameters that can fit in one another. This will enable the user to get the syringe out of the holding chamber (it will not get stuck).



2. Top View

The idea of the design is to initially fill the holding chamber with a desirable amount, and then attach the syringe mechanism over the top of the holding chamber. The hose connecting the bulb to bottle can remain attached or can be detached for user convenience. The user will use the bulb (attached) to force air into the syringe mechanism, which will force a rubber cork-like piece down towards the liquid. The pressure will force open the valve between the holding and delivering chambers transporting a desirable liquid into the delivering chamber. The liquid in the delivering chamber can be fed to a subject through one of the three mouthpieces suggested by the client, which include a pacifier, nipple, and cup mouthpiece. The advantages of this design include its versatility to incorporate a cup, bottle, or pacifier design, and ability to deliver any decided amount of liquid each time, ease of use because it's not too technical, and low cost of manufacturing. Some possible disadvantages include the fact that the accuracy of the amount of liquid delivered depends on the user, and it may be a problem to tip the entire mechanism each time a drink is taken. However, this later problem could be solved by connecting the holding chamber and the drinking chamber with a tube so that they could be moved independently of one another.