

CONTRAPTION SIMULATION

INTRODUCTION

The possibilities of building machines to solve everyday problems are very much limited by the creativity of the inventors. They range from the mundane to the most complicated and even wacky sort of machines ever built. Let's take the airplane as an illustration. Back in the early 1900s, the idea of constructing a flying machine that could soar through the air would have been considered unimaginable and even crazy. To the astonishment of many people at that time, however, the Wright brothers achieved the feat by building and flying the first airplane at Kitty Hawk.

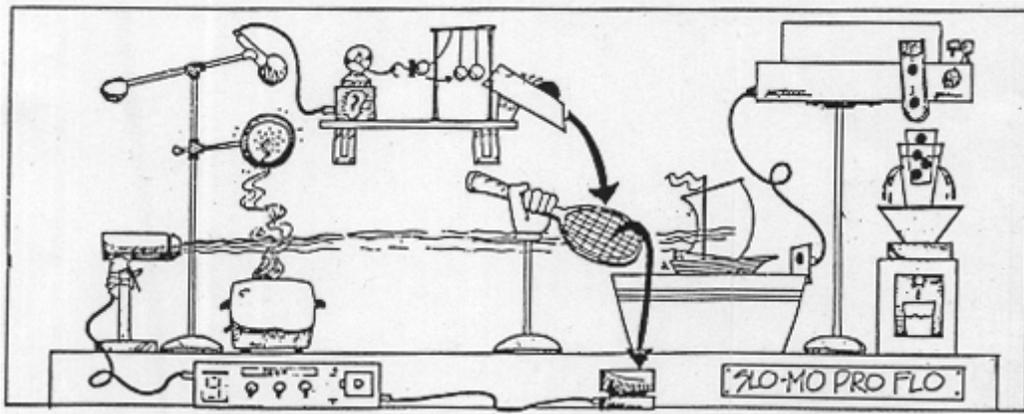
Among the many machine inventions, perhaps of relevance to our assignment would be the works of Pulitzer Prize-winning cartoonist, sculptor, and author, Reuben Lucius Goldberg* (1883-1970). Reuben invented incredibly complex and wacky machines to accomplish everyday simple tasks in the most complicated ways using simple machines like wheels, gears, handles and household items like cups, rods, balls, canary cages, pails, boots, bathtubs, paddles, and even live animals. (visit <http://www.rubegoldberg.com>).

Although Reuben's machines seemed "out-of-touch" with the real world, his ideas became very popular because he challenged the media to gain new perspectives of looking at how things work. For example, the annual National Rube Goldberg Machine Contest (named after him) held at Purdue University, Indiana-USA challenged many student contestants to build imaginative machines to perform specific tasks. The idea is to make them take a few steps back from reality and examine how things work from a totally new perspective by making the most complicated, roundabout device complete a simple task.

To be specific, groups are given an elementary challenge: something as simple as peeling an apple or, sharpening a pencil or putting toothpaste on a toothbrush. But instead of just "solving" the problem, students have to make the solution as complicated and as

convoluted as possible. In fact, the more steps - there's a minimum of twenty - the better the Rube Goldberg Machine.

A sample of an engineering student's version of a Rube Goldberg machine is shown below. The challenge is to build a machine that would fill a cup of water in 20 or more steps. The task is accomplished in true Rube Goldberg fashion by burning a waffle in a toaster, which sets off a smoke alarm, which activates a microphone, which then starts a small electronic motor, which...well, you get the idea. The cup of water is shown being filled at the lower right of the picture.



Typical example of a Rube Goldberg machine

WHAT IS CONTRAPTION?

In a nutshell, “Contraction” literally means a machine, device or mechanism put together by an assembly of objects and gadgets to meet an objective or to achieve some desired results.

In this assignment, we will use the Contraction Maker software (developed by [Spotkin](#)) as the tool to come up with machines to solve specific problems. The software has a library of building objects such as motors, generators, switches, plugs, gears, pulleys, conveyor belts, strings, etc. which allows the user to build machines of varying complexities. Also included are other items such as household appliances (e.g. blender,

fans, vacuum cleaner etc.), balls, balloons, explosives, rockets, and even animals such as cats and mice which can be used to simulate objectives and problems.

AIM OF ASSIGNMENT

This assignment challenges you to build and simulate your own incredible machines to solve specific problems in ways similar to the Rube Goldberg Machine Contest. In addition, you will be required to simulate and test out your inventions using the fun and interesting Contraption Maker software from Spotkin.

WHAT YOU NEED

The following items are required to carry out the assignment :

1. PC installed with [Contraption Maker Software](#)
2. Stationery

HOW TO BEGIN

You start by going through the tutorials provided in the Contraption Maker software. The tutorials range from easy to difficult. Familiarize yourself with the functions of each object and gadget provided in the library. Once you are ready to use the library components, you can proceed to build your own Contraption to perform your own specified objectives.

To accomplish a specific task, you have to pull out the relevant library components and position them strategically onto the stage. Next, link them together so that the initial action of one object triggers a whole sequence of other actions which finally arrive at the solution.

To simplify your work, you can begin by testing out small groups of objects first. Once they work properly, more objects can then be added onto the stage. Ultimately, all the objects must work together towards your goals.

Just as the Rube Goldberg Machine Contest cannot help students with their class assignments to build the Rube Goldberg Machines, by the same reason, we cannot dictate

how you should go about solving their tasks, since there are so many ways to solve a particular problem. However, we suggest that you start with the finish - what you are trying to accomplish - and work backwards step by step. Describe each step on a separate piece of paper. This allows you to change and edit your inventive machine step by step. After you've detailed each step in text and by a rough drawing you can start to build your inventive machine with a much clearer understanding of what you want your inventive machine to do, and how to achieve that result.

ASSIGNMENT 1

The bakery shop in your neighborhood was plagued by mice recently. The baker was at wits ends and decided to seek your help to come up with ingenious ways to address the problem. To simplify the problem, your objective is to build a device to catch **3 mice separately (not simultaneously) using 3 different mechanisms.**

Before developing the machine, you must first place 3 running mice on different platform. Next, explore and develop the mechanism that will help you to catch one mouse at a time.

You may use as many objects as you like, but they must be relevant to achieving the objective. Your device/mechanism should consist of no less than 5 objects (excluding the 3 running mice). Marks will be given for creativity and the number of actions generated, i.e. the more sophisticated the better.

ASSIGNMENT 2

The Top-Sports owner recently brought in three different types of sports balls (eg. basketball, soccer ball and bowling ball) and wanted to find out their relative weights. However, the shop weighing machine was damaged due to wear and tear, so the owner asked you to come up with some ingenious ways to determine the relative weight of the three ball types and tell him which ball type is the lightest, medium and heaviest. The relative weights should be determined through one program run only.

You may use as many objects as you like, but they must be relevant to achieving the objective. However, your device/mechanism should consist of no less than 5 objects (excluding the balls). Marks will be given for creative ideas and the number of actions generated, i.e. the more sophisticated the better.

ASSIGNMENT 3

Students from a primary school are learning about lights in their science class. You, the science teacher, wants to illustrate the principle of colored-light combination to the students using some form of training-aids.

The training aid should display at least the following :

1. blue light and red light produce magenta light
2. green light and red light produce yellow light
3. blue light and green light produce cyan light
4. cyan, yellow and magenta lights produce white light

Using Contraption Maker software, devise a visual training aid to illustrate principle of light combination (Hint : use colored lasers to replace light sources).

You can use as many objects as you like, but your device/mechanism should consist of no less than 5 objects. Marks will be given for creative ideas and the number of actions generated, i.e. the more sophisticated the better.

ASSIGNMENT 4

Devise a conceptual electrical system that allows you to switch on the following home appliances separately using a single triggering event :

- a. rotating fan
- b. kettle or egg beating machine
- c. blender or can opener

- d. vacuum cleaner
- e. toaster

You can use as many objects as you like, but your simulation should consist of no less than 5 objects. Marks will be given for creative ideas and the number of actions generated, i.e. the more sophisticated the better. (Hint : use a combination of motors and generators)

ASSIGNMENT 5

A certain manufacturing plant makes sports balls such as basketballs, bowling balls and baseballs. After these balls are manufactured and inspected, they are delivered via conveyor belts for packaging in boxes before being shipped out to their customers.

Your assignment is to devise a delivery system using motor, gears and conveyor belts to deliver and package three types of newly manufactured sports balls into their respective packaging boxes.

To develop the scenario, you can place three conveyor belts on the stage. The first conveyor belt consists of three basketballs, the second belt comprises three baseballs and the third belt consists of three bowling balls. Next, devise the gear and motor mechanism so that when the motor starts, all the three conveyor belts move together. The balls are then delivered to the end of the conveyor belts before they are pushed into their packaging boxes.

You can use as many objects as you like, but your simulation should consist of no less than 5 objects. Marks will be given for creative ideas and the number of actions generated, i.e. the more sophisticated the better.

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