

"How Things Work" Project Reports

Instructors: [Amitabha Mukerjee](#) and [M.K. Muju](#)

ME 371 Hands-On Lab, July-November 1999

<http://www.cse.iitk.ac.in/users/amit/courses/371/>

In this project student teams opened, broke, destroyed, and otherwise explored various devices, most of which (toys, clocks, taps, locks, switches, telephone) are commonly found around the house.

List of Projects

1. [Somersaulting Dog Toy](#)
Dilip Sah, Alok Tiwari, Amit Kumar

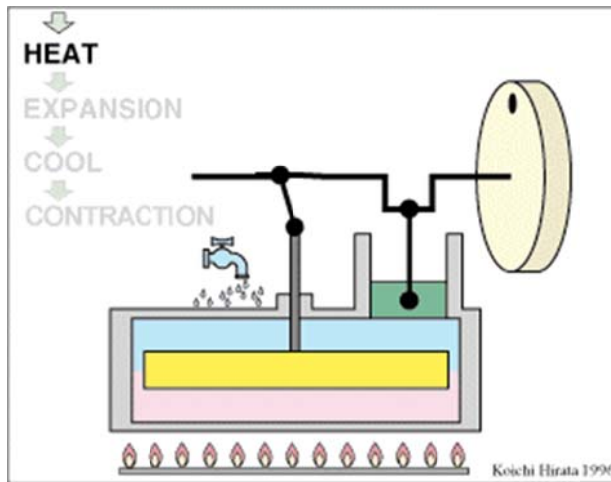


This adorable dog barks and walks. Then it stops, crouches on its rear legs and springs up to perform a somersault and land on its feet. Its plush body hides a clever mechanism that activates different geartrains by shifting a gear shaft through a face cam, causing a spring to wind up. The edge of the same cam controls the timing for releasing the spring, making the rear legs kick out: Voila - Somersault!

2. [Dial Telephone](#)
Anand Prakash, Anshul Pradhan, Bhavik Gupta

After releasing the dialler in a dial telephone, why does it return at a slow, controlled speed? Because it has this governor which controls the return speed - at a limiting r.p.m., the two brake halves bulge out against the spring to brake the motion. The dialling mechanism is a wonder of electromechanical design. A cam oscillates two leaf springs while a plugger prevents one from moving, thus breaking an electrical contact repeatedly (by the number dialled). Relays in the exchange then move up by the appropriate numbers, making the connection.





3. [Stirling Engine](#)

Abhishek Singh, Abhijit Tiwary,
Avinash Kumar

This group studied a Stirling Engine that was constructed last year at IIT Kanpur by Prof. P.K. Das. Air heated at the bottom expands and pushes the piston up which causes the displacer (yellow) to move down. This

displaces the air upwards, where it is cooled, causing the piston to come down. This image is from the page by [Koichi Hirata](#) which contains the most lucid explanations of how the Stirling Engine works. Discover the enormous potential of this highly efficient and invertible engine and how it is poised to change our lives in the near future.

4. [Tape Deck Mechanism](#)

Adarsh Garg, Mitul Saha, Manish K Misra

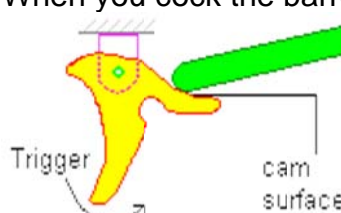
The tape-deck employs several sliding plates carrying pulleys and idlers that couple with two belt-driven pulleys to provide all the functionality of a tape-transport mechanism. Here is the clutch (pushed down by the spring) which runs at fast-forward speed but can slip when the tape is slowed down to a constant speed by the capstan.



5. [Air Gun](#)

Animesh Kumar, Brijesh Tripathi,
Ayon Dutta

When you cock the barrel to insert the pellet in an air gun, the piston is moved back and a spring is energized. A lever connected to the trigger holds the spring back. Upon releasing the trigger, the piston compresses the air in the cavity which propels the pellet. Let the [wonderful illustrations](#) by this group guide you through the intricacies of an air gun.



6. [Pendulum Clock](#)

Mudit Khandelwal, Deepak Jha, and Kamal Gupta



The pendulum is one of the oldest clockwork principles. This antique clock (circa 1910) is the

product of a long process of mechanical innovation. An interesting aspect is the use of needle gears (visible here) for transferring motion between sprockets. QUIZ: What causes the gong to sound every half-hour and hour? Find out about the escapement and how it controls the unwinding of the spring.

ANSWER: A notched wheel with deeper notches for every gong and shallower notches in-between where the gong ends. This runs in sync with the hour hand.

7. [Hard Disk Drive](#)

Naveen Tiwari, Amit Singh, Subhash Baudha, Rakesh Kumar

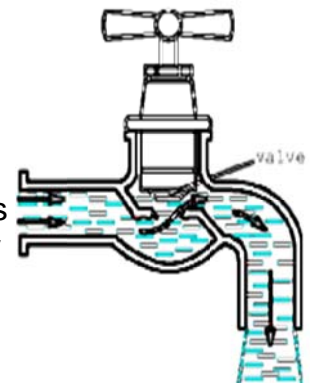


The parallel arms scurry in and out positioning multiple heads along the face of the platters. The gap between the head and platten is in microns to minimize magnetic flux loss. Meanwhile the disk is spinning at dizzying speeds to maximize data transfer rates, inducing a vacuum under the head (due to the high velocity air flowing through this gap). All this motion incuces some vibration, and if you have ever had a hard disk crash, it was probably because the head lightly scraped the surface. That this happens surprisingly infrequently is the marvel of this mechatronics design that is right now providing the data for this very display that you are reading!

8. [Water Tap](#)

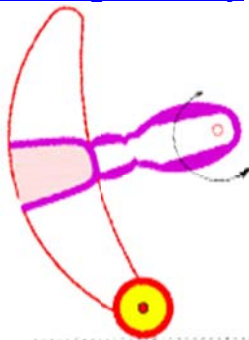
Jagmeet Singh, Gautam Sethi, Gaurav Ahuja

Water taps come in many shapes and sizes. Plastic taps are cheap. Brass is expensive. How do they differ? Why brass? What is a stopcock tap? Explore the many designs of this everyday household item.



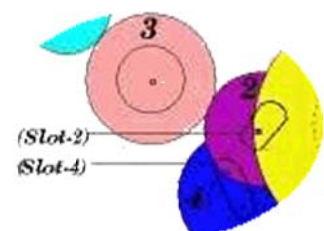
9. [Tumbling Monkey](#)

Mohit Kumar, Duttatrey Parashar, Ashish Mohan



Toys are an expression of unbridled creativity - there is so much we can learn from them. This monkey loops down with both arms while its tail is swiveling. It caterwauls and tumbles with prodigious energy to create a hilarious effect. Yet all that it has is two shafts turning at constant speed! The banana it holds is really a cam which lifts the body. There is a wheel at the tip to aid the instability when the tail

topples it from the back.



10. [Pull-back Car](#)

Vineet Khare, Shikhar Maini, Shahnawaz Faiyaz

When this toy car is pulled back a few inches, it travels right across the room. The energy must be stored quickly but released slowly. This is achieved using two different gear trains in the same tiny gearbox - when pulled back, the spring tightens fifteen times faster than when it unwinds. The innovation lies in two floating gears - the axes of gears 2 and 4 move along two slots in the gearcage depending on the tangential forces acting on them. Explore the [details](#) of this ingenious mechanism.