

Design Challenge Summary: Power Supply for the Kinkajou Microfilm Projector

Summary

Design that Matters is recruiting volunteers to assist in the design and development of a power supply for the Kinkajou Microfilm Projector. Our specific need is for a low-cost, 5-15W (or 15-50 W-hr/day) off-grid power supply. The Kinkajou is representative of a range of useful low-power appliances for underserved communities in developing countries, from medical devices to teaching tools, that appear slightly too big for a Freeplay radio-style hand-crank, and very small to justify the expense of a major solar power installation.

Background

One in five adults worldwide does not know how to read. In rural regions of West Africa, up to 75% of the population is illiterate. According to Barbara Garner of the World Education Organization, "It's the lack of resources"—specifically access to books and lighting—rather than the lack of interest in education that contributes to these numbers.



Night-time women's literacy course in rural Guinea



Student Team at MIT with prototype projection system



Microfilm Projection System in use in Bamako, Mali

Over the last two years, Design that Matters (DtM) has been developing a solution to this problem, in the form of a rugged, lightweight, low-power projection system. The Kinkajou Microfilm Projector uses a microfilm cassette to store up to 10,000 images at a fraction of the cost of paper books, and employs a state-of-the-art optics system to project an image large enough for the entire classroom to read.

In January 2005, DtM and partner World Education will conduct an extended pedagogical test of the Kinkajou projector in 50 villages in Mali. The field test will reach over 1,500 students, in classes ranging in size of 20 to 40 students. Content material is produced on 16mm microfilm and projected onto an appropriate surface or screen. A typical class time, or the projector duty cycle, is two hours per weekday evening.

The Kinkajou's targeted use in developing countries necessitates that power be provided by means other than an electrical grid. Our current power supply consists of a

motorcycle battery, a charge controller, and a 15W solar panel. The current power supply assembly costs \$130; our ambitious target is \$25.

Over 180 volunteers have contributed to the development of the Kinkajou microfilm projector, including professionals and engineering and business students at MIT, Worcester Polytechnic, Babson College and Cambridge University in the UK. For a history of the project, please see the Kinkajou Design Journal here: <http://www.designthatmatters.org/k2/>

Current technology:

As power is a premium, emphasis has been placed on minimizing extraneous current consumption and in designing a highly efficient illumination source. This has been achieved by employing manual operation to primary transport systems and by using a 5W white LED as the light source. Circuitry is provided in the projector to regulate the current draw, provide polarity reversal protection and monitor operating functions.

Power source selection for the current implementation was dictated by utilizing commonly available and replaceable portable sources in target countries, eg Mali. The most common source to be found in Mali is a 12VDC lead acid battery, typically used in car/truck or motorcycle applications.

One embodiment of the “system” combines a flooded lead acid battery from the sources sighted connected to the projector and a subsequent means to recharge the battery, the most probable source for recharge is via an auxiliary solar panel, typically 10-20W. Frequency of recharge is a function of the battery’s rated capacity and condition. (many batteries in developing countries are less than “rated condition”).

An alternate embodiment utilizes a 12VDC sealed battery, typically used in UPS, large powered toys, etc. This provides the advantage of safe portability, reduced weight and less expensive than car batteries, we are currently evaluating a 7ah battery of this configuration. Recharge will also be through solar panels, due to the 7ah capacity, daily recharge after a class session is required.

A final configuration under consideration is to utilize a commercially available 12VDC lantern, manufactured by Sollatek in the UK. This provides both a source of ambient lighting and auxiliary power which the projector can draw upon. The battery employed in the lantern is also of a sealed lead acid design, recharge is through accessory solar panel. This configuration is currently considered to be the leading candidate for the Kinkajou System.

Alternate battery technologies were considered as power sources, eg NiMH, and NiCad. These were not selected as they failed to meet the criteria of being readily available in target countries as well as negative disposal issues.

Opportunity/Challenge:

Design that Matters would like to consider alternate power modalities, primarily intended, but not limited to underdeveloped nation applications. Our goal is to develop/procure a power source which would be:

- light weight and portable
- extremely cost effective
- durable
- environmentally conscious
- highly reliable

Solutions need not be duplicate replacements of that employed today. For example, a very attractive alternative to chemical conversion, would be “human powered” sources. A number of commercial products exist today where human energy is converted and typically stored, to power portable radios (eg FreePlay); flashlights; electric razors and other low power consumer products.

Human power was briefly investigated for the Kinkajou project in the form of a bicycle powered generator to recharge a storage battery. The low reliability, overall size, and lack of general availability resulted in abandoning this option at this time. A brief investigation of those commercial products utilizing a “hand crank” led to the conclusion that the Kinkajou projector’s power needs were an order of magnitude greater than current technology provides and continuous “cranking” over a two-hour period was not physically viable.

Minimum Kinkajou Power Requirements and Operational Assumptions for use in design of a potential energy alternative:

Voltage	12VDC
Current	.7amps (1.0amps desirable)
Min continuous duty cycle	2 hrs on time
Reliability	10,000 hrs MTBF