Dancing Puppets- An Innovative approach to Learning Programming

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Abstract *— The objective of this work is to use traditional Folk Puppets (called Kathputli in Hindi) to make the process of learning more socially acceptable. Children are the key learners in rural society and provide a channel for their parents to learn modern technology. This channel is especially significant when the parents are illiterate or s emi-literate. In our current work with children in rural areas using simple robotic programming tools1, even lower -end programming systems such as LEGO Mindstorms are a) enormously expensive for a family whose monthly income is about $20, and b) alien in u sage and construction, and are difficult for the parents to accept. The Kathputli is envisaged as a low -cost, culturally familiar platform whereby digital technology can become more acceptable to village elders. Using it, the child is able to show the prin ciples of programming through the story enactment behavior of puppets, and in the process, demonstrate the validity of the programming that she learns. Also, the child is herself more motivated, for her programs move real objects instead of manipulating ab stract notions that are inside the computer.*

Index Terms *— Kathputli, Programming, Rural Education, Adult Literacy*

INTRODUCTION

The notion of programming goes deeper than writing lines of code; it demands a logical process of thought, the abiility to analyse a problem and develop its solution as an algorithm that may be implemented on a machine.

Introducing programming to children is a challenge more due to the interface presented by computer rather than by the act of programming itself. For children growing up in rural background, learning a simple C program to add two numbers will require knowledge of English language, and of the C language syntax. To demonstrate the idea, first consider a C code to add two numbers:

```
main ( ){
        int a = 2;
        int b = 3;
        int x  = a + b;
        printf(x);
      }
```

The output is “5” printed onscreen.

Secondly consider a graphical User Interface to write a drama sequence, with the help of already built icons, to move the hands and legs of a dancer, thus, depicting a walking figure (Figure 1).

Digital Kathputli is an interface between the traditional entertainment resources and digital tools, developed to provide learning through role playing and story telling. The concept provides an automated puppet control system with music-synchronized motions, to provide a platform to learn programming through story enacting.

Real puppets enacting a scene that he has just written, is something a ten year old child would love to see , and would feel naturally excited about. Without being conscious of it, he would have just written his first code to program. Children often express their creativity in the form of role playing, story telling and scenario enacting. Puppets offer great potential for role playing and story telling. Digital Kathputli is a model to employ traditionally available entertainment tools to promote learning and specially to demonstrate the fundamentals of programming with the help of motion control of puppets.

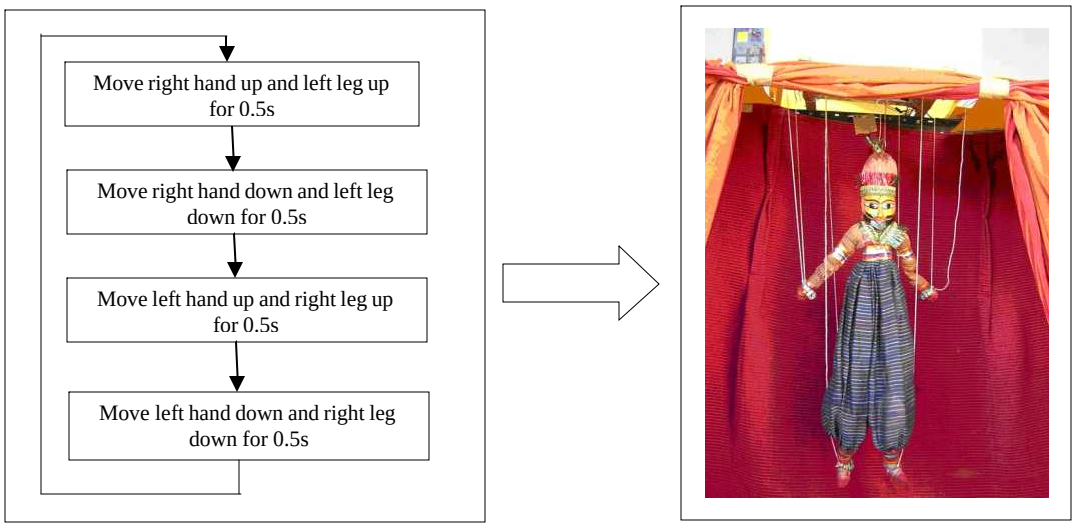


FIGURE 1
THE ALGORITHM FOR A PUPPET TO WALK AND ITS OUTPUT TO BE SEEN ON A REAL-LIFE KATHPUTLI

EDUCATION MODEL IN AN URBAN SETUP

In an urban setting, that is small towns/metropolitans, learning takes place through formal channels such as schools and universities and through mass media- mainly television, newspapers, books and magazines and most importantly, the Internet.

Parents, grandparents and other members of the family spend less time with children as compared to their rural counterparts. Thus, the role of teachers in an urban educational setup is crucial. Self-learning too is an important aspect of the urban child's education. In addition, children in cities are quick learners as far as technology is concerned. They learn to use household gadgets, hi-tech toys much faster than older users and have also shown ability to improvise and use their hi-tech toys for more than their intended design.

In this scenario, the Digital Kathputli system becomes a natural tool for teaching young students one of the most basic skills of the Information Age- the ability to program. Digital Kathputli proposes to make classroom learning fun- through the use of an attractive interface, i.e., traditional puppets, involve students in a hands-on approach to learning- through the user friendly GUI, and encourage them to innovate- through the concept of tangible programming.

EDUCATION MODEL OF A VILLAGE

An Indian village is somewhat an autonomous society, with the *Panchayat* as its governing body. Individuals are influenced by each other's behavior more than in an urban society. Thus, learning of new principles is mainly achieved by mutual interaction. This motivated us to follow a two-stage education model within a rural setting.

Learning of a Child

Children are the key learners in a rural society. They learn from school, teachers, parents and other children. A child's acts are motivated in the direction, in which he sees encouragement. A subject, which is understood and appreciated by both child and parent, will be learned more efficiently than the one, which can't be frequently discussed with parent. In case of illiterate and semi-illiterate parents, these subjects can't be modern technology related, and thus we decided to employ a traditional platform to demonstrate learning principles, which will allow the involvement of parents and simultaneously will allow the children to learn the new technology.

Learning of Parent

The adult mind acquires only that information from the child, which they understand is relevant. For example, a child's brain mimics the language of his parent, because of the adaptive nature of the child's brain, but the adult brain doesn't allow him to learn the child's language, understanding it as irrelevant. Had the child been practicing grammar of French Language, which is partially known to the adult, he would have tried to learn it. When the parents are illiterate or semi-illiterate, learning becomes more difficult, because of the parent's assumption of unknowingness of the basic principles behind the task. To illustrate this point, children, who know the principle behind Cholera vaccine, are not able to convince their illiterate parents, how injecting the disease virus will help them cure the disease. Here if we could provide them a social platform, which connects the understanding of parents with the knowledge the children are acquiring, than the parents will be able to learn indirectly from their children. Thus we are acquiring the objective of increasing awareness in parents through children via a traditional platform.

DIGITAL KATHPUTLI

The word *Kathputli* originated from the Hindi words *Katha* (story) and *putli* (puppet), which made it a synonym for a story of puppets. Their long history of unpretentious drama and simple mystification goes back to the dawn of civilization. Wherever the origin may be, but today in India, one can see a totally different puppet map, in every state. From the string controlled *Kathputli* of Rajasthan, and the shadow puppets of Maharashtra called *Chamdyacha Bahuliya* to the glove puppetry of Bihar, and *Putala Nach* of Assam, the colors are indeed numerous.

How the Kathputli show started

BRiCS (Building Robots Creating Science) is a group of volunteer students at Indian Institute of Technology, Kanpur. The objective behind BRiCS is to promote the concept of Hands-on-education in Indian education systems. Workshops in schools are an easy media to realize this objective. Early workshops of BRiCS were a success in the urban schools. Later on, as we focused on the rural education, we identified that rural children were not comfortable with standard construction kits with gears, shafts and English software. The reason that we analyzed was that, the rural children were not able to correlate, how can they model their day-to-day life objects to the functionality provided by these construction kits. Thus an interface was required between the new programming functionality, and their rural minds.

What can be a better interface, than to automate puppets- time-tested icons used traditionally to pass on folklore? What fun will be there to control those strings, that too without putting hours to specialize how the puppeteer controls so many strings simultaneously. We started at once, borrowed puppets, and by the evening, the village children had made a whole story enacting with the help of Lego motors and the RCX microprocessor. Little help was required, while using the programming software. And the day ended, and we had to pack up. Here started the motivation to develop a model, which will keep to the lower side of cost versus technology graph, without sacrificing the technology.

IMPLEMENTATION

The autonomous puppet system was designed to be as close as the real puppet shows as possible. For this, a rigid iron structure was used to build the stage. The background consisted of changeable drapery, based around the story being depicted. Individual motors controlled the movements of hands and legs. The motors are geared DC motors, controlled through a set of H-Bridges, for logic to power voltage conversion. They are interfaced through parallel port with a PC to be programmed through the story programming software, 'Katha'. Development of a commercial version of the kit is in progress.

Katha - Write your own story

Katha is the synonym for story in Hindi. The Katha software is made on the concept of a timeline (as implemented in any video editing software), which provides the functionality necessary to write a story, in the form of a sequence of actions. Example of a fight between Rajput warriors is one of them. He can use the basic commands like "move hand" and "move leg" for enacting scenes containing the following puppet movements:

1. Shake hand
2. Walk

3. Dance
4. Music synchronized dance

Such short scenes could be built with the basic actions and can be stored as modules for enacting the whole story. What this means is that one doesn't have to write the scenes of a duel between two people, every time, there is one such scene. He can just refer to the module "Fight".

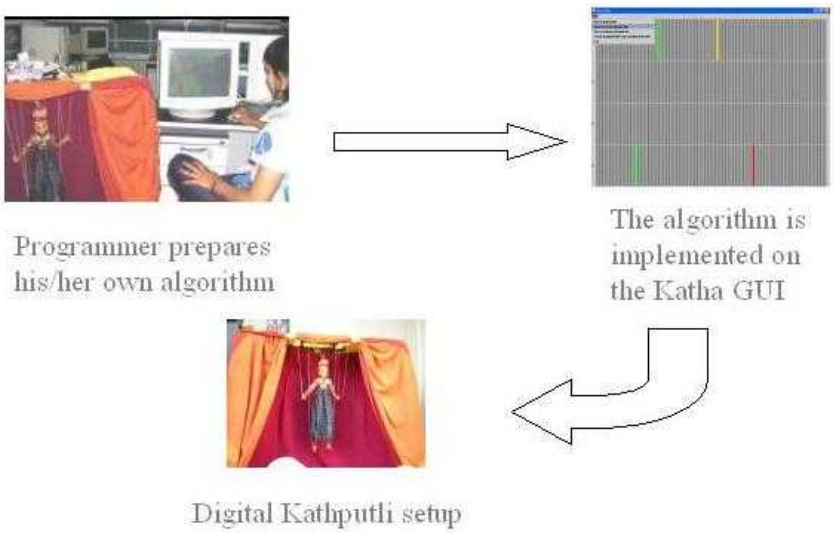


FIGURE 2
A PUPPET BEING CONTROLLED THROUGH THREE MOTORS VIA PARALLEL PORT COMMUNICATION

COGNITIVE LEARNING OUTCOME

The initial prototype developed by the authors using Lego Mindstorm's programming hardware was demonstrated at the Toy Design Festival *'Another Toy Story'* held at IIT Kanpur. Students from nearby villages and urban schools took great interest in the idea, and tried programming the puppets on different folk music. Later on the students of *Barasirohi Primary School* at a BRiCS workshop rebuilt the prototype. Feedback is taken from the Primary school students, which showed the following cognitive learning outcomes:

- Learnt to use an interface of information and communication technology and traditional entertainment.
- Carried out a personal project of a mythological story enacting using the digital Kathputli kit
- Engaged in problem solving with respect to motor control, and dialogues casting.
- Explored puppet vocabulary development.
- Participated in cooperative learning activities between the cycles to foster teamwork.

The current setup of the Digital Kathputli Kit was introduced to students in 10 urban schools (children of affluent parents, familiar with technology and the latest gadgets) and to students studying in 5 schools belonging to neighboring villages (Lodhar, Nankari villages surrounding the city of Kanpur). Due to their different backgrounds, the two sets of children reacted to the concept in different ways, but with a fundamental similarity- they were excited by the entire idea of tangible programming, and wanted to have the setup integrated into their coursework. The differences in their reactions involved the extent to which they were attracted to the cultural aspect of the Kathputli setup, whether they considered the setup better utilized for the purpose of storytelling or for exploring programming puzzles.

SURVEY ANALYSIS

A. Chart 1 shows the reactions of the rural school students who participated in our study:

In each category shown above,the students and teachers gave more detailed reaction.They thought that Digital Kathpulti is capable of :

1. Education:

- being an effective tool to teach younger siblings.
- Helping them learn the use of the computer.
- providing greater understanding of any subject than rote learning.
- teaching simple concepts of science.

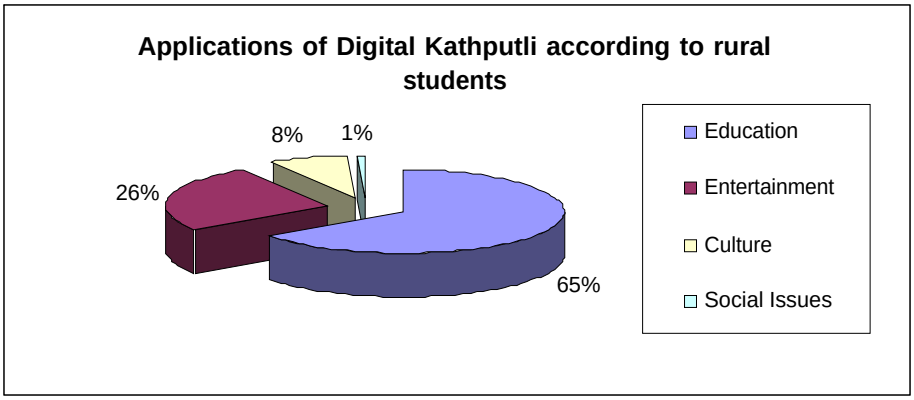


CHART 1

2. Entertainment:

- Performing dance and plays.
- Enactment of stories.
- Bringing the stories made by students to life.

3. Culture:

- Spreading awareness about Indian Culture, notably mythological stories and folktales e.g Ramayana, Mahabharata.

4. Social Issues:

- Enacting skits to spread social awareness.
- Concept of "Puppets without a puppeteer" appealed to children.

B. Chart 2 shows the distribution of responses from students from urban schools who participated in the study:
These categories are further classified as follows:

1. Tangible Programming:

- Increased understanding of the concepts of procedural programming.
- Provides an interactive platform to learn programming by implementing stories as algorithms and seeing the output as a live puppet show.

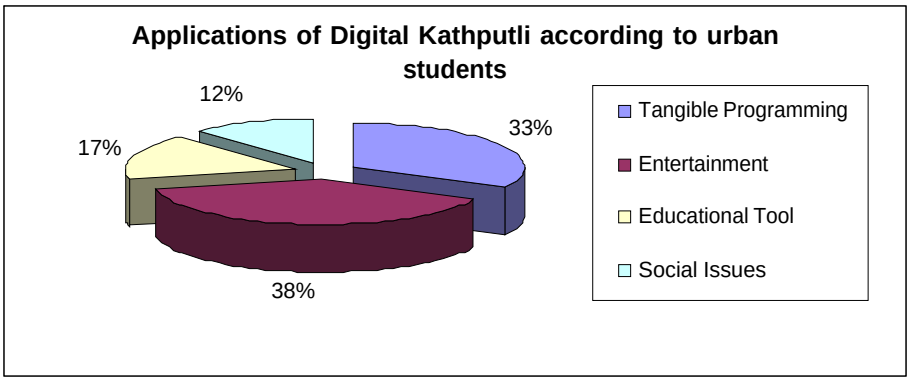


CHART 2

2. Entertainment:

- An effective means to revive the dying art of puppetry with the help of modern technology.
- Possible use as a tool for choreographers to simulate dance steps and thus design dance shows.

- Tool for enactment of plays for recreation.

3. Education:

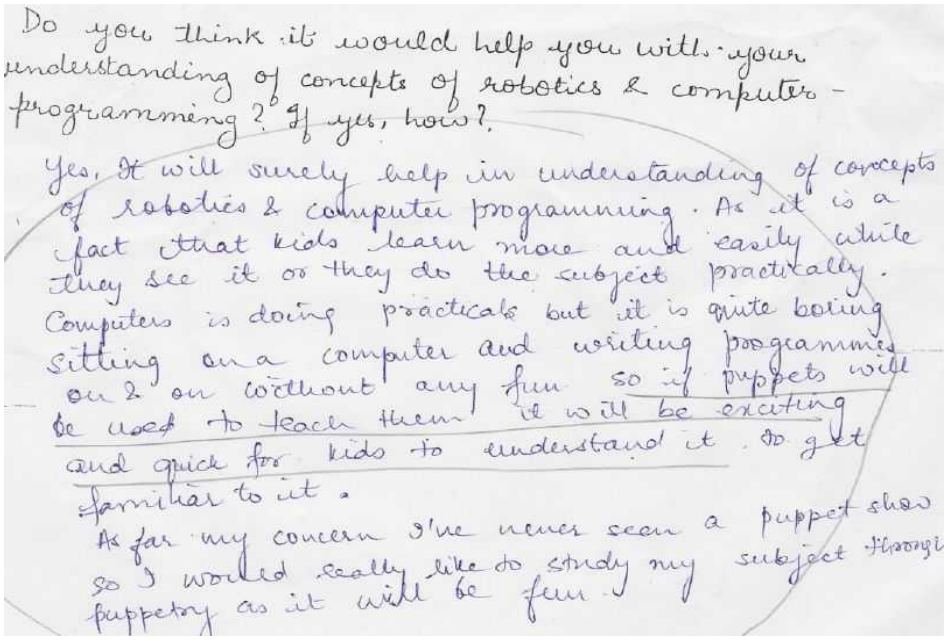
- An attractive and interesting way of teaching alphabet and numbers to kids.
- Fun aspect in learning with puppets.
- Several science principles can be explained and demonstrated using the Digital Kathputli setup. Examples could be depicting the Big Bang Theory by using different puppets as the particles in space,initially all held together as one big mass and finally separating.The disorder in the universe can be represented by chaotic movement of puppets which would gradually decrease depicting the initiation of order.
- Teaching history lessons by enactment of wars,revolutions etc would make learning interesting and fun.

4. Social Issues:

- Organization of plays using Digital Kathputli setup to create awareness among people towards issues like dowry, in polio campaigns etc.
- Imparting moral values through enactment of stories from Panchtantra, Aesop's tales etc. using the Digital Kathputli setup.

From the feedback obtained from the students and teachers, it is evident that Digital Kathputli is considered an effective source for learning programming effectively. The students found the concept of learning through hands-on–approach more appealing than rote learning. The Digital Kathputli kit increases scope for experimenting and exploring new ideas and hence, enhancing the creativity of a student. The implementation of new algorithms in an interactive environment enables the student to understand the basics of programming in a better and efficient manner..Further, the use of traditional tools makes it easier for rural children to adapt to new technology and hence learn the basics of progrtamming. The use of puppets, an icon familiar to village adults, is an important factor in overcoming rural resistance to the introduction of new technology.

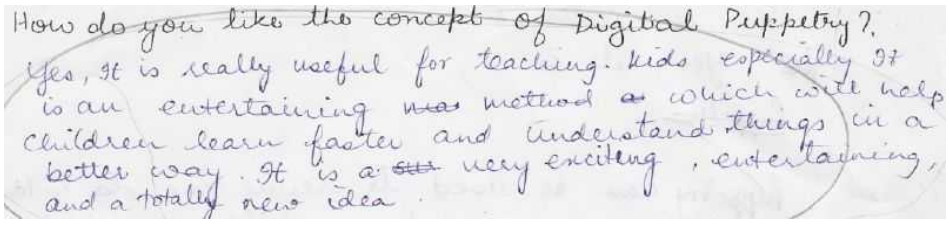
Some representative samples of the answers we recieved during our survey:


Do you think it would help you with your understanding of concepts of robotics & computer programming? If yes, how?

Yes, It will surely help in understanding of concepts of robotics & computer programming. As it is a fact that kids learn more and easily while they see it or they do the subject practically. Computers is doing practicals but it is quite boring sitting on a computer and writing programmes on & on without any fun so if puppets will be used to teach them it will be exciting and quick for kids to understand it. So get familiar to it.

As far my concern I've never seen a puppet show so I would really like to study my subject through puppetry as it will be fun.

FIGURE 3


How do you like the concept of Digital Puppetry?

Yes, It is really useful for teaching. kids especially It is an entertaining ~~was~~ method ~~a~~ which will help children learn faster and understand things in a better way. It is a ~~the~~ very exciting, entertaining, and a totally new idea.

FIGURE 4

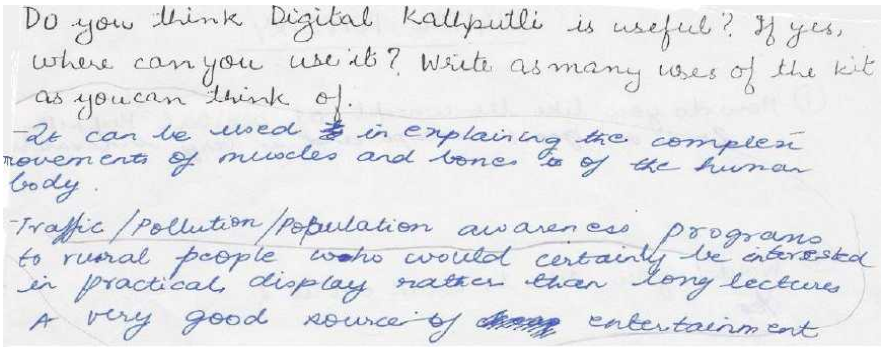


FIGURE 5

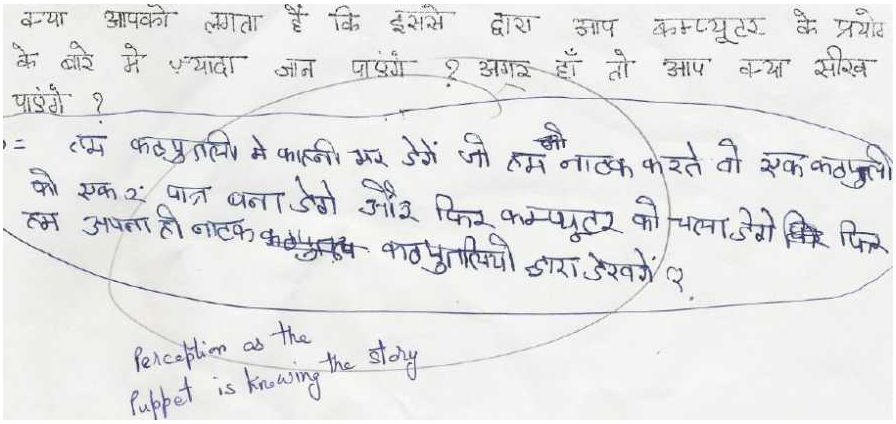


FIGURE 6
A RURAL STUDENT'S RESPONSE IN HINDI LAGUAGE

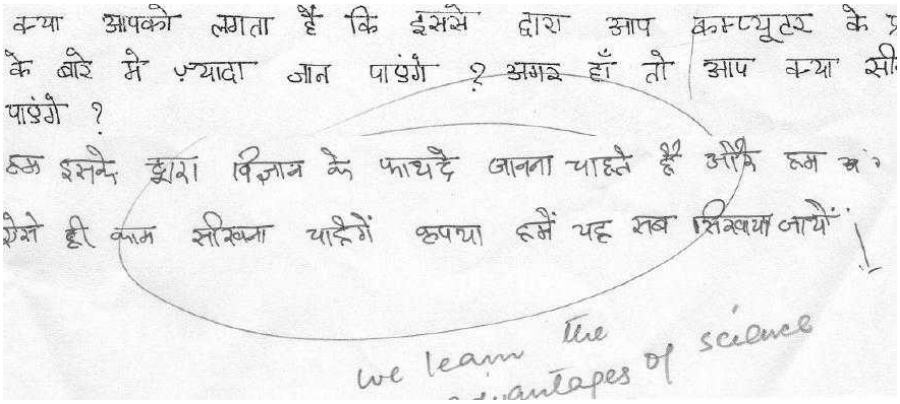


FIGURE 7
A RURAL STUDENT'S RESPONSE IN HINDI LAGUAGE

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