Kolam

On understanding certain *kolam* designs

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ABSTRACT

Kolam is a form of traditional Indian folk art that is widely used in Southern part of India as threshold decoration in front of dwellings. Kolam Practitioners, mostly women, memorize the complicated *kolam* designs using some syntactic rules. There are different types of *kolam* patterns in which dots or pullis and lines or curves are used. In this paper, we examine a *kolam* pattern called *Hridaya Kamalam* in which five pullis are marked on eight converging arms in radial form and they are joined by lines using certain rules.

Hridaya Kamalam kolam is generalized to contain m arms and n pullis in each arm. The number of unending lines (*kambis*) needed to complete the design is also obtained. For a design with m arms and n pullis, the number of *kambis* required to complete the pattern is given by the HCF of (m,n). When m and n are prime to each other, the pattern contains only one unending line.

A class of *Hridaya Kamalam kolam* is generated by choosing different values for the number of arms m and the number of pullis n. An algorithm for generating these designs is implemented on a Genie I Computer. The pullis can be joined by straight lines, circular arcs or any other form of curves. Curves that will be more pleasing to the eyes can be generated for getting attractive designs.

I. INTRODUCTION

Kolam or *rangoli* is a form of traditional Indian folk art used widely in Tamil Nadu , Karnataka and Andhra Pradesh as threshold decorations in front of dwellings. There are different types of *kolam* patterns in which dots or pullis, and lines or curves are used. The *pullis* are marked on the floor first and then using certain rules these pullis are joined either by straight lines, or smooth curves [1]. Kolam Practitioners (KPs) , mostly women , memorize different *kolam* patterns and draw them in their dwellings. Narasimhan [2] has drawn the attention of computer scientists to study how the KPs memorize complicated *kolam* patterns and examine whether they make use of any syntactic rules that underlie *kolam* designs. Formal language theory has been successfully applied and the properties of certain types of *kolam* designs have been studied extensively by Sirornoney , Siromoney and Kritihivasan [3,4,5]. In this paper we examine a particular *kolam* pattern called *Hridaya Kamalam* which is a stylized form of lotus flower, and study the variations of this design often completed by a single unending line (*kambi)*

II. Hridaya Kamalam Kolam

Hridaya Kamalam kolam in its most common form has eight converging arms or axes and each arm is of 'length' five units. KPs memorize this design by marking the five pullis on the eight converging arms in radial form. In practice, the directions of the arms are memorized and only pullis are marked along the directions. Then they memorize a sequence of numbers which they apply repeatedly to join the pullis. This sequence of numbers is the rule that is used to form the petals of the *Hridaya Kamalam kolam* (Figure 1).

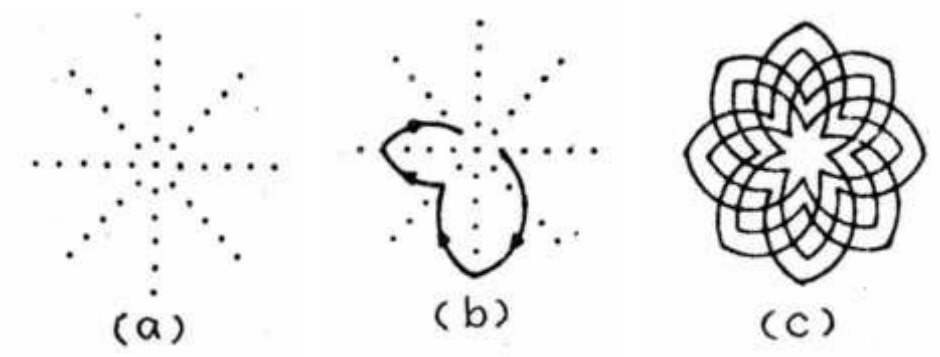

Figure 1.
a. Skeleton of the *kolam* with eight arms of length five each,
b. The kolam is drawn following the tracing sequence <1,3,5,2,4 > .
c. Acompleted *Hridaya Kamalam* design.

Let the *pullis* be marked as 1,2,3,4 and 5 on each of the arms from the center 0. The sequence of *pullis* to be joined is given by <1,3,5,2,4>. This sequence of *pullis* are joined from one arm to the next, starting from any one of the arms arbitrarily. The same sequence is repeated until the design is completed, that is, no *pullis* left out in any arm. This pattern requires only one *kambi* . The points can be joined either in the clock-wise or counter clock-wise direction. The shape of the *kolam* drawn in the clock-wise direction will be the mirror image of the *kolam* drawn in the counter clock-wise direction.

III. GENERALIZATION

The common *Hridaya Kamalam kolam* is generalized to have m arms and n pullis in each arm. We examine the general rules that will produce designs resembling the *Hridaya Kamalam kolam* with varying number of arms and *pullis* (arms are of constant length in each design, but varying between different designs). We also find the number of *kambis* that are required to complete a generalized design.

Let m arms of certain length 'n' units emit from a point 0 (center) with an angle $\theta = 2\pi/m$ between any two consecutive arms. The arms are numbered as l,2,3,..,,m in the clock-wise direction. Each arm is divided into n equal parts and they are marked as l,2,3,,..,n from the center 0. Let P denote the permutation group of the set N = {1,2,3,...,n} and let A = $\{a_1,a_2,...,a_n\}$ be a member of P. In fact, A represents the sequence of *pullis* to be joined from one arm to the next. We call A the tracing sequence. The *Hridaya Kamalam kolam* is now traced as follows.

We start with the initial point $x_1 = (a_1,1)$, where the first element in the ordered pair represents the *pulli* and the second represents the arm. Successive points to be joined are determined using the following transformation.

If $x_k = (a_i, j)$ is the kth point then the next point to be joined is obtained as
$x_{k+1} = f(x_k) = f(a_i, j) = (a_1, J)$
where I = i (mod n) + 1 and J = j (mod m) +1.

In figure 1, the *Hridaya Kamalam kolam* with eight arms and five *pullis* that is, m = 8 and n = 5, is shown. The sequence of *pullis* used for tracing the *kolam* is A = $<a_1, a_2, a_3, a_4, a_5>$ = < 1, 3, 5, 2, 4>.

Thus a *Hridaya Kamalam kolam* is characterized in terms of the number of arms, the number of *pullis* and the tracing sequence, that is, (m,n,A).

It is also possible to obtain a closed loop or *kambi* before completing the *kolam*. This situation arises when the starting point is reached before all the pullis are traced in the pattern. In such a situation, we start again with an arbitrary starting point in the next arm and continue to trace the *kolam*. This process is continued until no *pulli* is left out in any arm. This process leads to the following interesting question. "For a given (m,n,A) what is the number of *kambis* required to complete the *kolam* ?" . To answer this question we give the following proposition.

PROPOSITION : 1

For a *Hridaya Kamalam kolam* (m,n,A), the number of *kambis* or unending lines required to complete the *kola*

Proof : Let x_1 x_2 x_3..... x_{mn} be the totality of points in the design. Let us assume that we come to the starting po
Therefore, mn/r = c
=> mn/c = r = um = vn
=> mn= (uc)m = (vc)n.

This implies that both m and n are multiples of c and hence c is a factor of m as well as n . Since we have cho

Thus we establish that when m and n are prime to each other, the pattern contains only one unending line.

Since the tracing sequence A is taken as an arbitrary member of P, the above result holds for any member of

This also implies that the kolam patterns obtained for the members of P are isomorphic to one another as eac

Figure 2 illustrates the *Hridaya Kamalam kolam* patterns for the following specifications,
(a). (m,n,A) = (6,2,(1,2)) and
(b). (m,n,A) = (9,3,(1,3,2)) .

The number of unending lines required for the first specification is 2 and for the second specification it is 3.

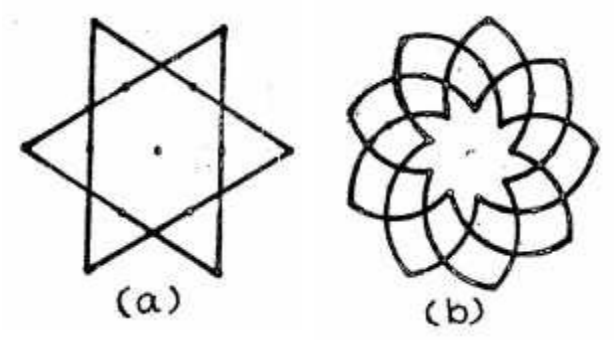

Figure 2. a) A *kolam* pattern with six arms of length two each, with the tracing sequence <1,2> .

b) A *kolam* pattern with nine arms of length three each, with the tracing sequence <1,3,2>.

A computer program is written for generating a class of *Hridaya Kamalam kolam* for any given specification (r

IV. CONCLUSION

A threshold design called *Hridaya Kamalam kolam* is generalized to contain m arms and n pullis in each arm.

A computer program has been written to simulate the drawings of the *Hridaya Kamalam kolam* for a given spe

It is now possible to generate a variety of new designs of the *Hridaya Kamalam kolam* type which can be use

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