**1.3. Questions asked to clients/users for arriving at objectives, constraints and functions:**

|  |  |
| --- | --- |
| **Questions such as** | **This question helps the designer to** |
| 1. Is the sand art machine automated? | **Establish client’s objectives** |
| 1. Is it easy to assemble and disassemble? |
| 1. Is it portable? |
| 1. Can it perform in variety of environments? |
| 1. What can be the size of the robot? | **Identify constraints** |
| 1. Can it be affordable at a lower price? |
| 1. Can the time taken to accomplish the task be made less? |
| 1. Can the robot work on its own judging the situation? | **Establish functions** |
| 1. Can the system draw any complicated designs? |
| 10.Can it recognise different patterns and draw on its own? |

Table 1. Questions to be asked to clients/users

Obtain the information through basic survey and customer interaction and arrive at requirements

|  |  |
| --- | --- |
| **Observation and from Lit.Survey** | **Requirements** |
| 1. Based on the weight of the robot | The system’s total weight should not exceed 2kg. |
| 1. Based on the cost of the product | The cost of the robot should not exceed Rs 4000. |
| 1. Sand art consumes a lot of time | It should be able to accomplish the task in under 10 minutes |
| 1. Area required to complete the assigned task | The whole process should be carried out within an area of 1 sq. m. |

Table 2. Basic survey and customer interaction to arrive at the requirements

**1.1.** **Identify client’s objectives**

|  |  |
| --- | --- |
| **Sl. No** | **Objectives** |
| **01** | The robot should be automated |
| **02** | Robot should be easy to assemble and disassemble |
| **03** | The robot should be user-friendly and operate efficiently |
| **04** | The robot should be small in size and easily portable |
| **05** | The robot should be able to perform in a variety of environments |

**Step 1:** Preparing a list of design objectives

Table 3. List of design objectives

**1.2. Prioritize the identified design objectives**

Priority among various objectives is set through a technique called Pair-wise Comparison Chart (PCC)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Objectives** | **Working process** | **User friendly** | **Cost** | **Score** |
| **Working process** | \*\*\* | 1 | 1 | 2 |
| **User friendly** | 0 | \*\*\* | 1 | 1 |
| **Cost** | 0 | 0 | \*\*\* | 0 |

Table 4. Pair-wise Comparison Chart (PCC)

Rank the objectives in order of decreasing value of importance and the list is

1. Robot should not require supervision after initial set-up and alignment.

2.The robot should be easily customisable.

3.It should be able to perform in variety of environments.

4. The robot should be user-friendly and operate efficiently.

5.The product should be available at an affordable price.

*Based on the information gathered through interaction with client, initial survey and completing phase 1.1 the problem definition is formulated as follows:*

***Problem definition v*ersion1.1**

*“Design an automated sand art robot which is easily customisable and can perform in a variety of environments. It should be user-friendly and operate efficiently without any glitches.”*

***1.2 Identify constraints***

1.The product should not weigh more than 2 kilograms.

2.The cost of the product should not exceed more than Rs.4000.

3.The robot should be able to complete its task under 10 minutes.

***Problem definition v*ersion1.2**

*“Design an automated sand art robot which is easily customisable and can perform in a variety of environments. It should be user-friendly and operate efficiently without any glitches. The product should weigh around 1-2 kilograms and cost of producing it should not exceed more than Rs. 4000.Also, the robot should be able to complete the assigned task in less than 10 minutes”*

**1.3 Establish functions**

***1.3 Establish functions***

1.The robot should be able to recognise different patterns and carry out the task it is assigned.

2.The robot should be able to design any complicated design.

3.The robot should be able to judge its responsibility and work accordingly.

***Problem definition v*ersion1.3**

*“Design an automated sand art robot that can recognise different patterns and carry out the task assigned in an efficient manner without giving any room for error. It should be able to move on its own, judging the directions and perform in a variety of environments. It should be user-friendly, easily portable and can be set up in an area of nearly 1sq metres. It should be able to perform any designs. The product should weigh around 1-2 kilograms and cost of producing it should not exceed more than Rs. 4000. Also, the robot should be able to complete the assigned task in less than 10 minutes and alert the user after the completion of the process.”*

**1.3 Establish functions**

1.

2.