

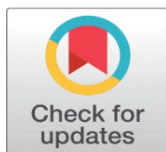
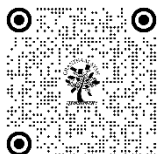


3D PRINTING TECHNIQUE TO DOCUMENT AND PRESERVE TRADITIONAL DESIGNS OF CHANNAPATNA TOYS

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ABSTRACT

Dasara Doll festival is a tradition during the Navaratri Hindu festival celebrations in South India. The festival of Navratri is celebrated in a very interesting and unique way at homes, which is commonly known as Bombe Habba or Golu or Kolu (Kannada) or Bommala Koluvu (Telugu) or Bommai Kolu (Tamil) or simply Dasara dolls. This tradition involves a toy festival that is celebrated by families across Karnataka and Andhra Pradesh, Tamil Nadu. Family toys are arranged and displayed to invited guests as part of the festival. Channapatna town close to Bangalore and Mysore is the hub of the toy making industry catering to the demand for such toys. Artisan families have been engaged in the manufacture of toys for many centuries. Designs and manufacturing techniques remained within artisan families and the knowledge transfer is through word of mouth from parents to children. Kondapalli Toys of Andhra Pradesh are made by artisans in Kondapalli which is located close to Vijayawada in Andhra Pradesh and has a similar history. The changing lifestyles in the present day have altered the way festivals are celebrated, and the patronage of such traditional crafts is on the decline. The creation of an express highway between Bangalore and Mysore has changed the road route and bypassed Channapatna town reducing the footfalls at the retail shops which sold toys for hundreds of years. Artisans are forced to explore other avenues of employment and the risk of losing the art technique is real. The portfolio of designs is dwindling, and many models are very rare and difficult to obtain from the market; they become antique collection pieces of a few individuals. Conserving the designs through CAD techniques and making prototypes using 3D printing is an effective way to preserve them. CAD documentation can be used to train a new generation of artisans or enthusiasts across the country. This will open new markets for the products and will sustain the art and design. This paper attempts to outline the technique and make a few 3D-printing prototypes with detailed drawings and present the results.

Keywords: 3D-Printing, Channapatna Toys, Sustaining Traditional Artisan Techniques, Toy Prototypes, Toy Drawings

1. INTRODUCTION

India has a rich tradition of wood carving and idol making dating back to thousands of years. Mahabharata describes an architect (Purochana¹) designed

¹ In the Hindu Vedic texts, it is mentioned that Purochana was an Architect in the ancient kingdom of Hastinapura. He was known to have created the palace Lakshagriha, also known as the House of Lacquer [Lakshagriha \(2023\)](#).

lacquer place-Lakshagriha built at the behest of Duryodhana as an assassination plot to kill Pandavas [Lakshagriha \(2023\)](#).

Figure 1

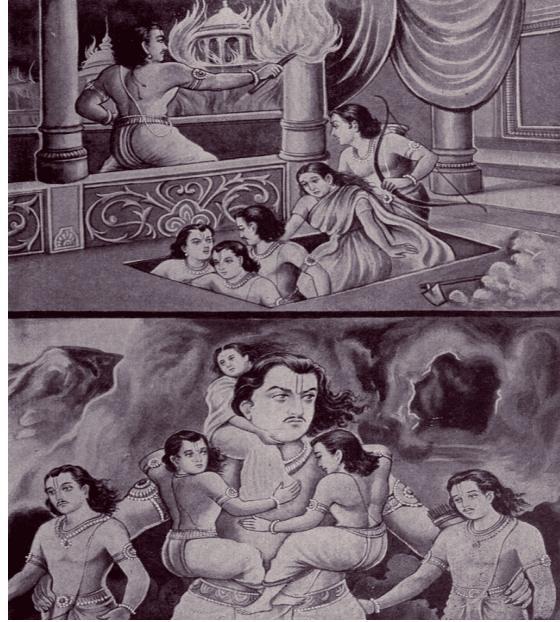


Figure 1 Illustration Showing the Escape of Pandavas from [Lakshagriha \(2023\)](#)

The Puri Jagannath temple is said to be thousands of years old and mentioned in Hindu Puranas [Jagannath Temple, Puri. \(2023\)](#). In the planning of the temple, the inner sanctum of the temple contains deities of Jagannath, Balbhadra, and Subhadra. The idols are carved from neem logs, and they are changed or replaced once in 8th,12th or 19th year based on tradition [Sengar \(2019\)](#), [Nabakalebara \(2023\)](#). The Nabakalebara ceremony marks the occasion of installing new idols. Dedicated artisan families are involved in this sacred work [National Informatics Centre, Govt. of India. \(2023\)](#).

Figure 2



Figure 2 Wooden Nabakalebara Toys that the Hindu Deities [Nabakalebara \(2023\)](#)

Carved temple doors, idols have encouraged and patronized artisans to preserve and improvise their craft for thousands of years.

1.1. LITERATURE SURVEY

There are very few books published on the topic of traditional toys of India.” Indian Toys Come Alive” by Dr. Vijaya Gupchup [Gupchup \(2004\)](#) is an excellent book documenting toys that are preserved by several generations.

Dynamics of Folk Toys by Sudarshan Khanna published by Office of the development commissioner Delhi is a rare book that documents the scientific design aspect of traditional Indian folk toys [Khanna \(1983\)](#), [Khanna \(2022\)](#).

There are many research articles published on Indian toys. For the purpose of this paper the following articles are reviewed.

Tradition of Toys in India is more than 5000 years old. The Harappa and Mohenjo-Daro excavations yielded toys like small carts, dancing women etc. Hindu mythology, epics and the tradition of storytelling have a great influence on Indian Toys. Each state in India has a unique and distinct style of toys.

Figure 3
Indigenous toys of India



Figure 3 An Illustration of India Map and Miscellaneous Images of Traditional Wood Toys from Different States [Toys of India- Indigenous Toys of India. \(2020\)- Indigenous Toys of India. \(n.d.\)](#)

Table 1

Table 1 List of States and their Traditional Toys Native to the Location [Toys of India - Vikaspedia. \(2023\)](#)

States of India	Handicrafts Native to the State
Andaman & Nicobar Island	Timber toys, coconut shell toys
Bihar	Horse & Rider, Bamboo toys, Toy horse, cloth dolls, turtle toys
Chandigarh	Wooden Boards & showcase, Wooden Jali, Sunmica Boards, God Statues
Chhattisgarh	Clay & terracotta, Dhokra metal casting, wood carving, metal craft toys
Daman & Diu	Tortoise shell toys and crafts
Goa	Wooden Toys, Soft toys, Coir Toys
Gujarat	Puppets, Stuffed Toys Made of wood & cloth, Clay toys and figures

Haryana	Babushka dolls, lacquer dolls, string puppets, clay Indian toys, leather stuffed toys
Himachal Pradesh	Wooden Toys
Jammu & Kashmir	Walnut wood carving, Paper Mache
Jharkhand	Wooden toys, Painted cloth dolls, toy archery
Karnataka	Channapatna toys
Kerala	Kothakali dance dolls, animal shaped toys, Woodcraft
Madhya Pradesh	Adivasi Gudia Hastashilpa (dolls) Betel Nut Toys, Tin toys
Maharashtra	Wooden Toys of Sawantwadi, Bahatuktli
Odisha	Paper Made Toys, clay toys, wooden toys, aplic
Punjab	Folk toys, Handwai, Chankana Lattu, Ghuggu
Tamil Nadu	Thanjavur Thaluyatti Bommai, Choppu saman
Telangana	Nirmal toys
Uttrakhand	Wooden Toy making
West Bengal	Toys, Terracotta Toys, Wooden toys, Batik Print Cloth toys, Bamboo Musk

Many Indian Toys and toy-based games are on the verge of extinction. The following are a few examples of such games. Deep research and serious efforts are needed to revive them.

- Bagh Chal ² (Tiger and Goat) A board game that involves the strategy of the goats to obstruct the path of tigers and being hunted down [Bagh-Chal. \(2023\)](#).

Figure 4



Figure 4 The Above Images Shows the Traditional Bagh Chal Board Game [Ray \(2015\)](#)

- Pachisi ³- This is a four-arm colorful board game. Players throw dice or cowrie shells to move the four pawns allotted to each player. The objective of the game is to move the pawns allotted to each player as fast as possible to complete the round of the board [Lloyd \(2018\)](#), [Pachisi \(2022\)](#).

² Bag Chal is to have originated in Nepal [Bagh-Chal. \(2023\)](#).

³ Pachisi is also known as Ludo and it is said to have originated in India, as recorded in the ancient text Mahabharata [Pachisi \(2022\)](#).

Figure 5

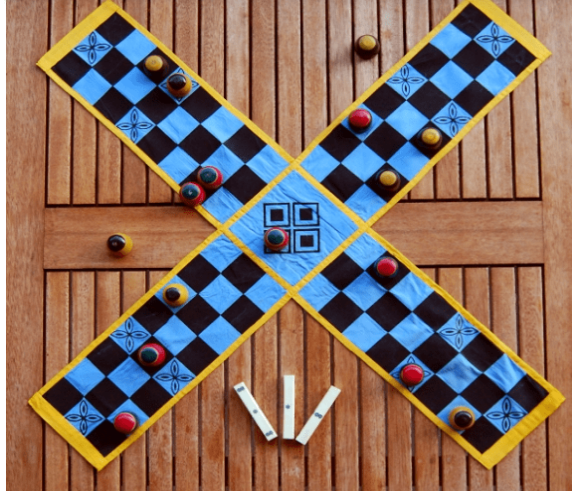


Figure 5 The Above Image Show Us How the Four Arm Board Game Pachisi was Played Ray (2015)

- Chaturanga ⁴ is the predecessor to modern chess. Four players play the game with two players teaming together. Each player gets eight pieces -Four pawns, one elephant, one horse, one bishop and one elephant. A single stick dice is thrown by the players to initiate the movements Bodlaender (2023).

Figure 6



Figure 6 The Four Player Chess Like Game Chaturanga Ray (2015)

1.1.1. DASARA DOLL FESTIVAL

Dasara is a traditional festival that is celebrated across India, as the concluding tenth day after Sharad Navarathri festival. The Sharad Navarathri festival falls during the first fortnight also known as the Ashvinyuj month (Kannada/Telugu Lunar Calendar) during the months of September/October every year. Every Indian state has a unique way of celebrating the festival. Garba dance in Gujrat, Ram Lila is widely celebrated in North India, and Durga Puja in West Bengal are part of Navarathri

⁴ Chaturanga is another strategy board game that originated in Ancient India Bodlaender (2023). As per records, Chaturanga means "four-limbed" or "four arms" in Sanskrit, referring to ancient army divisions of infantry, cavalry, elephantry, and chariotry Bodlaender (2023).

celebrations. In the South Indian states of Karnataka, Andhra Pradesh, Tamil Nadu and Telangana, the doll festival is celebrated across homes [Sadananda \(2016\)](#).

It is called Gombe Habba in Karnataka, Bommala Koluvu in Andhra Pradesh and Telangana and Bomai Kolu in Tamil Nadu. Dolls are arranged in a nine-step pyramid arrangement. Goddess Durga, Sarasvathi, Ganapathi, Shiva, Krishna, Vishnu are placed on the topmost step and other dolls are placed in the lower rows based on individual family tradition and family doll collection. In Andhra Pradesh and Telangana some families celebrate the festival during the Makara Sankranti Festival around January too [Rotti \(2017\)](#).

Figure 7



Figure 7 An Illustration of the Tier Arrangement of Gods [Sadananda \(2016\)](#), [Kanchana \(2023\)](#)

Figure 8



Figure 8 An Arrangement of Dolls Showing the Gods and Goddesses in the Upper Tier Followed by Other Doll Series [Sengar \(2019\)](#)

Figure 9**Figure 9** Another Arrangement Showcasing the Different Dolls [Rotti \(2017\)](#)

Artisans of Channapatna produce beautiful wooden toys and no doll arrangement is complete without the presence of Channapatna toys. Demand and patronage has encouraged artisans of Channapatna for hundreds of years to produce different designs and preserve this art form. Channapatna Toys are historical dating back to hundreds of years. The available literature talks about designs that (1782-1999AD). Very little information is available regarding traditional designs before this period.

1.2. CHANNAPATNA TOYS

The process of making the Channapatna toys is interesting, and every piece is said to be made by hand by the artisans with the assistance of a few tools [Salma \(2023\)](#). The local artisans also use other types of wood to sculpt the toys, like rubber, sycamore, cedar, pine, and teak. Rosewood and sandalwood are sometimes used to make expensive and exotic designs. Lacquer and Vegetable dyes are used to give aesthetic finishing touches to the toys.

Figure 10**Figure 10** (a) An Artisan Making Beads by Hand [Salma \(2023\)](#)(b) An Image of Channapatna Bead Keychains [Kanchana \(2023\)](#)

Channapatna toys have a long history dating back to hundreds of years. During the period of Tipu Sultan [Craftdeals in Admin. \(2023\)](#). Syed Bawa Saheb Miyan also known as Bawas Miyan visited Japan twice and brought the technique of using wood lathe machines to increase the production quantity and quality of the toys.

Channapatna toys are made out of wood and finished with vegetable colors. They are less toxic when compared with mass produced plastic toys. Large quantities of toxins present in plastic toys pose a danger to children while they play with toys. Eco-friendly wooden toys are a good alternative to plastic toys, and they are catching the attention of ecology conscious people [Rangaswamy et al. \(2018\)](#).

Dr. Mahadeswara Swamy in his article [Swamy \(2018\)](#) talks about how Channapatna toys are made traditionally using the Ivory Wood tree. The tree is called as such due to the wood turning to ivory/white in colour with age. The common name of the tree in Kannada is- Beppale/ Hale Mara and the scientific name is *Wrightia tinctoria* belonging to the family Apocynaceae [Swamy \(2018\)](#). The tree is said to be native to India, and other countries [Wrightia Tinctoria \(2022\)](#). It also has medicinal properties as well.

Channapatna toys have a wide variety. Simple games, playful toys, Hindu deities, the repository is huge. Rapid urbanization and people moving to cities and living in small apartments slowly reducing the patronage to Channapatna toys. Newly inaugurated Bangalore Mysore express highway bypasses the Channapatna town [Ammembala and Mohapatra \(2022\)](#). The roadside shops of Channapatna were the traditional points of sale for toys. Due to the highway, the daily footfalls to these shops have drastically reduced. Lack of selling avenues may force the artisans to abandon their traditional manufacturing activity and switchover to other jobs. The art and traditional designs are facing the risk of extinction [Ammembala and Mohapatra \(2022\)](#).

Figure 11



Figure 11 A Display of Channapatna Toys [Ammembala and Mohapatra \(2022\)](#)

This paper attempts to document the designs using CAD techniques and make prototypes using 3D printing techniques. The purpose is to preserve the rich tradition for posterity and also encourage artisans in other parts of the world to attempt making replicas.

1.3. VISIT TO CHANNAPATNA TOY FACTORY

Figure 12



Figure 12 Travelling to the Channapatna Town (Photo: [Kanchana \(2023\)](#))

Channapatna Town is around two and half hours' drive from Bangalore. The newly inaugurated express highway bypasses the town. Due to the highway, travelers have to exit the express highway and drive a few kilometers to visit the Town. The following pictures capture a typical toy factory with artisans at work.

Figure 13



Figure 13 (a) A Visit to One of the Local Toy Factory, Bharat Art, and Crafts Channapatna Toy Factory [Kanchana \(2023\)](#),

(b) A Craftsman Busy at Work,

(c) A Display of Wooden Toy Horse [Kanchana \(2023\)](#)

Figure 14



Figure 14 Different Displays of the Various Toys Made at the Factory [Kanchana \(2023\)](#)

Figure 15



Figure 15 Various Artisans Busy at Work in the Production of the Handmade Toys [Wooden Toys Supplier in Channapatna Toys Manufacturers in Channapatna. \(2023\)](#), [Kanchana \(2023\)](#)

Manufacturing units Bharat art and crafts are striving hard to keep the tradition and gainfully employ local artisans [Wooden Toys Supplier in Channapatna Toys Manufacturers in Channapatna. \(2023\)](#).

2. OBJECTIVES OF THE RESEARCH STUDY

Due to the lack of patrons and artisans abandoning their traditional crafts, the portfolio of Channapatna toys is reducing day by day. The object of this applied research is to explore and experiment with modern CAD based tools to document the traditional and rare designs so that designs can be preserved for posterity and designs can be reproduced in the future.

2.1. SIGNIFICANCE OF RESEARCH STUDY

Traditionally design knowledge is gained by artisans by working as interns under the supervision of senior and elderly artisans. Research and development for developing physical products involves creating prototypes and testing them. This is applied research to solve a business/industrial problem. There are many tools and techniques available. 3D printing is an emerging technique to quickly make prototypes based on any design before investing in expensive tools for mass production. This paper attempts to use 3D Printing technique to build prototypes of rare Channapatna toys with an objective of preserving the design and passing it onto the next generation of artisans.

2.2. 3D PRINTING TECHNIQUE

3D printing is a process of constructing a three-dimensional object from a CAD 3D model. Three dimensional solid objects can be manufactured from a digital CAD file using 3D printing technique. It is an additive manufacturing process enabled by software and hardware equipment. An object is created from a digital file by laying down successive layers of material. Several thinly sliced layers are made till the final object is made.

Figure 16

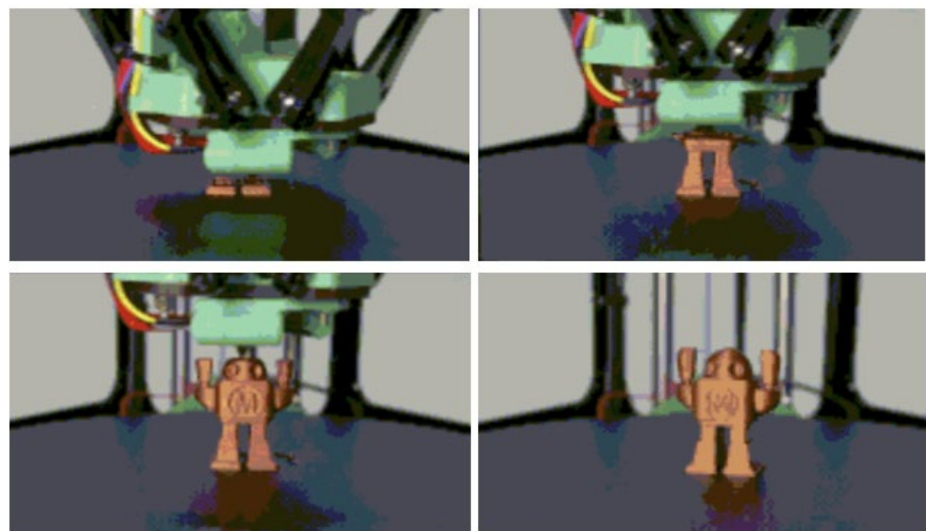


Figure 16 Robot 3D Print a Timelapse Model on Reprappro [Robot 3D Print Timelapse on RepRapPro Fisher \(2023\)](#)

3D printing technique was first proposed by Murray Leinster in 1945 is a short story [Wikipedia \(2023\)](#). In the year 1980 Hideo Kodama from Nagoya Industrial Institute Japan filed a patent for XYZ plotter and invented two additive methods for fabricating three-dimensional plastic models [Wikipedia \(2023\)](#). A photo hardening thermoset polymer was used in the process. Hardening of the polymer was controlled by a scanning transmitter. However, this technology did not materialize in a commercial scale equipment.

In the year 1981, American entrepreneur Bill Masters filed a patent for a computer-based manufacturing process. It is one of three related patents that laid the foundation for modern 3D Printing technique.

Over the years industry has invested huge amounts of money to build software and hardware equipment to mature the technique. Nowadays, entry level 3D printers are available for as low as US\$ 200/ making it a viable tool for any additive manufacturing process.

During the initial years of development, 3D Printing used polymers for printing due to the ease of handling and using the material. However, modern 3D Printing has evolved to handle metals and ceramics. This has opened and extended the scope of 3D Printing from manufacturing prototype models to strong engineered objects which can become the backbone of various applications.

3D Printing technique is being extensively used in replicating archeological artifacts, historical buildings etc. The factum Arte is a 3D printing company which had taken the task of documenting the 3000-year-old tomb of Pharaoh Tutankhamun. The company used various modern techniques for the documentation, like digital photography, 3D laser scanning and 3D printing to recreate the murals and artifacts with precision [Shaikhnag et al. \(2014\)](#).

Figure 17



Figure 17 An Image of a 3D Printed Sculpture of an Egyptian Pharaoh [Shaikhnag \(2014\)](#)

Figure 18

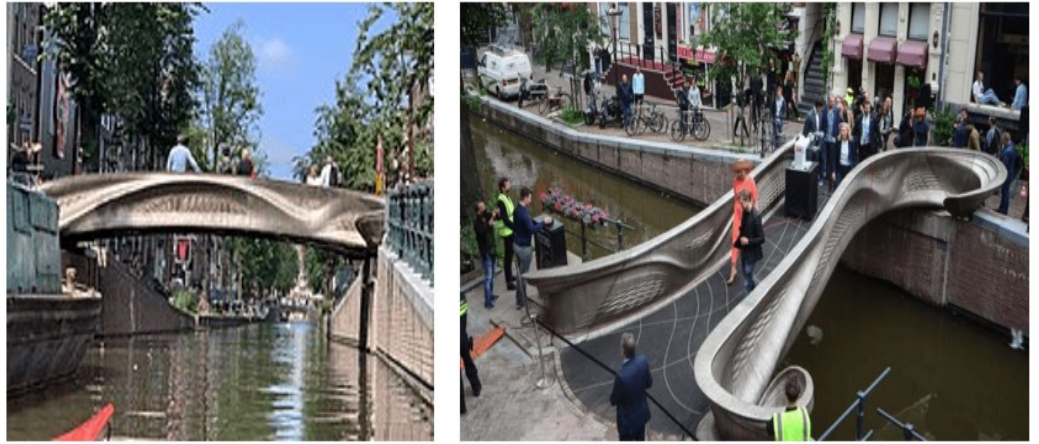


Figure 18 The 3D Printed Metal Bridge in Amsterdam [Sharma \(2021\)](#)

In India, there is rapid development taking place in the field of 3D printing. There is an ongoing project where the proposal is to construct a Post office in Bengaluru using the 3D printing technique [Abraham \(2023\)](#).

Figure 19



Figure 19 The Above Image Shows the 3D Printing Construction at Work [Abraham \(2023\)](#), The Construction is Undertaken by the L&T Company [Prasad \(2023\)](#)

3D Printing has a great and promising future. Prosthetic limbs/body parts, homes and buildings, firearms, edible things, musical instruments are being built using the technique.

This paper attempts to explore the technique to document, preserve and replicate Channapatna toys.

3. THE 3D PRINTING OF CHANNAPATNA TOYS

Channapatna Toy shown in the following image Figure 20 (a), is chosen for the purpose of creating a 3D digital model/file as a preliminary step to 3D printing. The following steps are involved in creating the 3D model:

- Making detailed 2D drawings of the toys in the CAD software.
- Then exporting the model to the 3D modelling software Sketchup or any equivalent 3D modelling software (3Ds-Max, Blender etc.).
- And then exporting the 3D file in a SLT file format for 3D Printing the toy model.

Figure 20

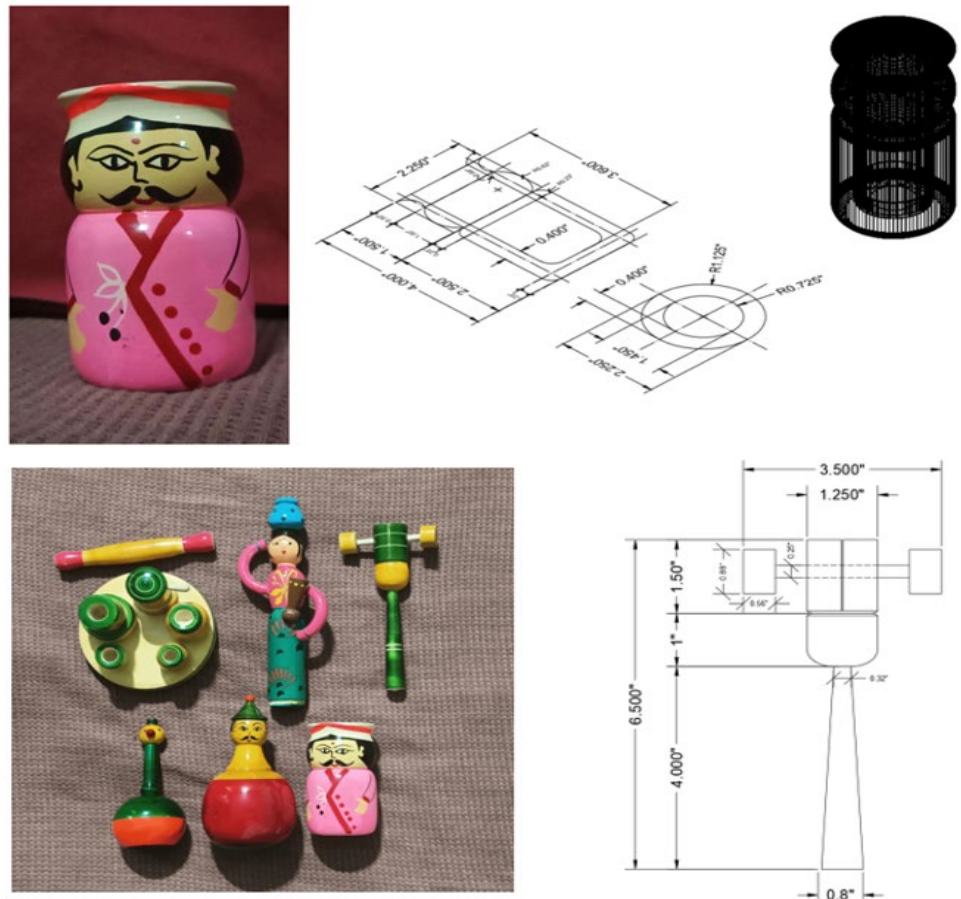


Figure 20 (a) Channapatna Toy Pencil Holder 2D and 3D Detail is First Documented [Kanchana \(2023\)](#)

(b) [Kanchana \(2023\)](#),

(c) (a) A Pencil Stand Holder Channapatna Toy is First Documented,

(b) Collection of Different Channapatna Toys for Documentation [Kanchana \(2023\)](#), [Kanchana \(2023\)](#)

Figure 21

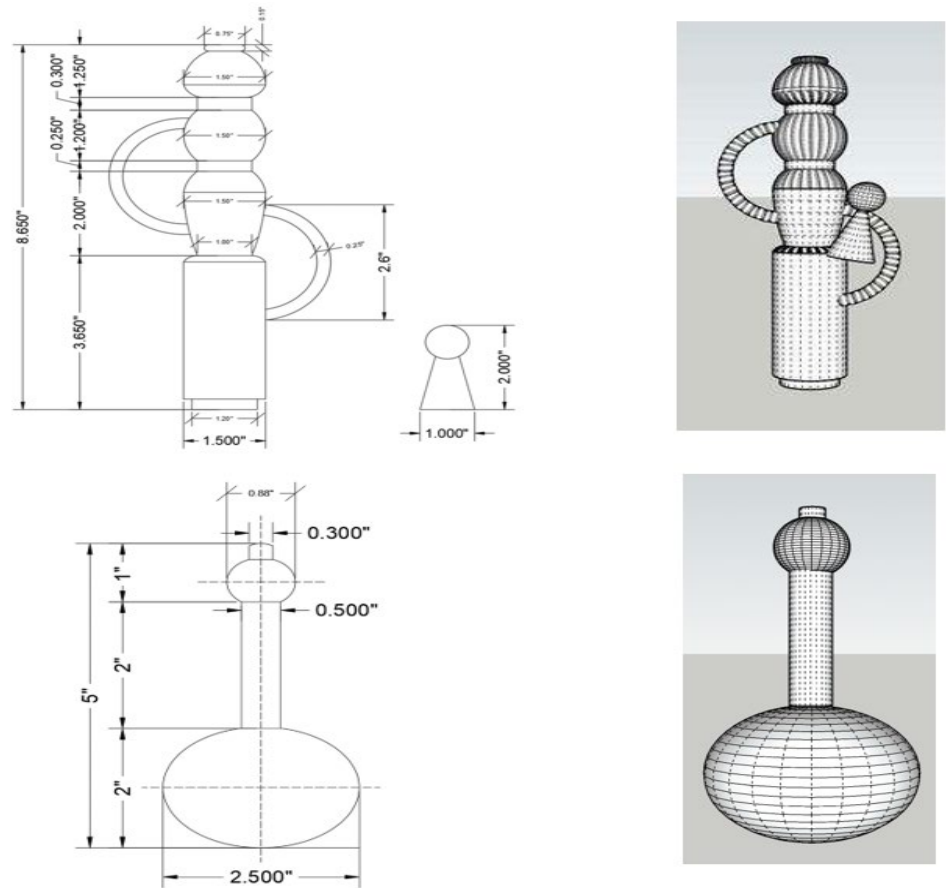


Figure 21 2D and 3D Documentation of Other Channapatna Toys [Kanchana \(2023\)](#), [Kanchana \(2023\)](#)

4. PROCESS OF 3D PRINTING

The following equipment is used to build the 3D Printing model.

For making 3D Printing, PLA-Poly Lactic Acid is used. PLA is eco-friendly and produced from renewable resources. This is the most consumed bioplastic in the world. It is typically made from corn, cassava, or sugarcane [Polylactic acid \(2023\)](#).

Fused Deposition Modeling - FDM 3D Printer is used to make the prototype [What is FDM \(fused deposition modeling\) 3D Printing? Hubs. \(2023\)](#).

Extrusion 3D printing is an evolving technology. Models are made using wood filaments. Material used here is wood fibre extracted from wood chippings (around 20-30%) and polymer resin for bonding (around 60-70%) [Polylactic acid \(2023\)](#). This process can give samples which are very close to [Wooden Toys Supplier in Channapatna Toys Manufacturers in Channapatna. \(2023\)](#). Further research is ongoing in the process of 3D printing objects using wood filament through trial-and-error basis. There are guides to print the objects with different methods [Theias \(2022\)](#), [Wikipedia \(2023\)](#).

Figure 22



Figure 22 A 3D Printed Wood Filament Pot, The Sculpture was Sanded After the 3D Printing Process
[Theias \(2022\)](#)

5. EXPERIMENTAL RESULTS

Images of 3D artifacts of Channapatna Toy are reported below. The PLA sample weighed 200 gms. Commercial charges for 3D-Printing are around Rs 10 per gram.

Figure 23



Figure 23 Finished 3D Printed Channapatna Toy is Shown in the Figure [Kanchana \(2023\)](#), [Kanchana \(2023\)](#)

5.1. SCOPE OF FUTURE WORK

Serious effort and deep research are needed to obtain extinct toys from museums and art collectors. Many man hours of effort is needed to create detailed 3D drawings and funding is needed to obtain 3D Prints of these toys to preserve them for the benefit of posterity.

6. CONCLUSION

Changing lifestyles, urbanization and road infrastructure changes have resulted in reduced patrons to Channapatna Toys. Artisan families who are involved in the traditional manufacturing activity are abandoning the trade and taking up other

avenues of employment. There is a risk of losing the traditional designs. 3D Printing is futuristic technology which can be used to build aesthetic prototypes. The process of preparing 3D drawings of Channapatna Toys to enable 3D printing will preserve the designs for posterity. This paper has considered two rare Channapatna Toys and made detailed CAD drawings. 3D Printing technique is used to build a prototype of one of the toys. Experimental prototype built and reported in this paper is very promising. Drawings and prototypes can be made for all Channapatna designs which are current and an effort can be made to obtain antique pieces for the purpose of digitising the design. The techniques and results reported in this paper will go a long way in preserving the design. Artisans elsewhere can use the results and replicate the designs too.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

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