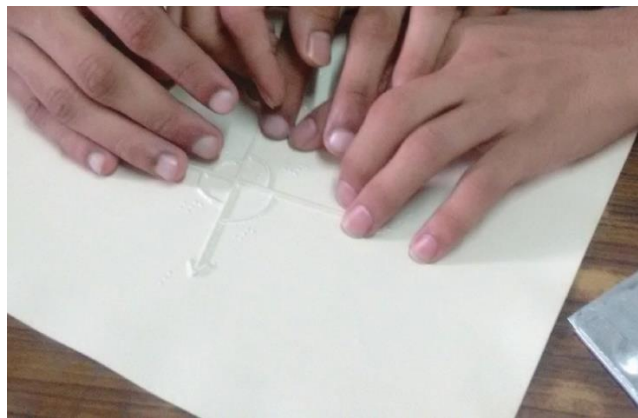


# Executive Summary



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1. Title of the Project: Tactile Diagrams for Visually Impaired
2. Date of Start of the Project: August 1, 2018
3. Aims and Objectives: Tactile diagrams enable perception of two dimensional pictures/images through touch. These are embossed outline drawings which are specially designed for individuals with visual impairment and blindness in order to communicate pictorial information. Students with visual impairment and blindness can attempt to study subjects that are heavily dependent on graphics like geography, mathematics, science etc if tactile diagrams can be produced in an affordable manner. The present endeavor is to develop technology-based solutions for development of affordable tactile diagrams and books to address challenge of accessible education.



Tactile Diagrams

4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment etc)

A new Section 8 company named Raised Lines Foundation (RLF) has been formed and incubated at IIT Technology Park in Sonapat, Haryana under the chairmanship of awardee (P.V.M. Rao). The start-up has facilities for small scale production of tactile diagrams. The design team of RLF converts diagrams prepared for visual route to learning to that of tactile route to learning. The production team uses 3D printing and thermoforming to produce tactile diagrams. These two units work closely with users and stakeholders. Since its inception,

Technology of Tactile Diagrams has been used prepare number of accessible books/documents for various organizations which include Tactile atlas for survey of India Dehradun, Tactile Guitar manual for Golden Shine Institute, Delhi, Accessible textbooks for Vision Empower, IIIT Bangalore, NCERT Mathematics and Science books of various classes under Samagra Siksha Abhiyan, Chandigarh.

Another work related to tactile diagrams has been undertaken and completed for Red Fort. Recently, British-era Army barracks at Delhi's Red Fort were converted into museums. The barrack museums have been filled with artworks and archival records related to the Indian Independence movement. A selection of artworks from the main exhibition is converted into tactile reproductions with the help of tactile diagram production facility. of new startup.



Launch of NCERT Economics Book



Tactile Gallery at Red Fort, New Delhi

Some of the research and development undertaken as part of this fellowship include:

- Design, Production and Dissemination of Tactile Diagrams.
- Development affordable materials for tactile diagrams

- Design, Manufacturing and Inspection Automation of Tactile Diagram production.
- Understanding Tactile Perception for Improved Tactile Diagrams.
- Comprehension of 3D Information from 2D Tactile Diagrams

#### Selected Publicationss

Richa Gupta, P.V.M. Rao, M. Balakrishnan and S. Mannheimer, Evaluating the Use of Tactile Shapes in Associative Learning, Paper accepted for publication in Journal of Visual Impairment and Blindness.

Arshad Nasser, Arshad, Taizhou CHEN, Can Liu, Kening Zhu, P. V. M. Rao, FingerTalkie: Designing A Low-cost Finger-worn Device for Interactive Audio Labeling of Tactile Diagrams, Paper accepted for publication in HCI International 2020, Copenhagen, Denmark, 2020.

Tigmanshu Bhatnagar, Vikas Upadhyay, Anchal Sharma, P.V.M. Rao, Mark Miodownik, Nicolai Marquardt, Catherine Holloway, Drawing Erasable Tactile Diagrams on Tacilia" Proceedings of 2021 IEEE World Haptics Conference (WHC), July 6-9, 2021, Montreal, Canada.

#### PATENT FILED

A SYSTEM AND METHOD FOR DETECTING CHARACTERISTICS OF AN EMBOSSSED SURFACE OF A SHEET

#### 5. Concluding remarks

There has already been some impact of technology developed for realization of tactile diagrams. Raised Lines Foundation, a social enterprise incubated as a part of this fellowship has produced more than 2 Lakh tactile diagrams covering about 40 titles which has reached more than 3000 visually challenged students in about 30 towns/cities of India.