

# Women empowerment by technology supported manufacturing of beads from Holy Basil

Rajkumar Gupta, Mangal Sharma, Davinder Pal Singh, Bhivraj Suthar and Subir Kumar Saha\*

Rural Technology Action Group, Indian Institute of Technology Delhi, Hauz Khas, New Delhi 110 016, India

**In this article, we demonstrate how intervention using basic technology has improved the manufacturing of the beads from the stems of Holy Basil (Tulasi). This has helped the convenience, productivity and income of those women in the villages who typically make the beads in the Brij area (Mathura, Brindavan and nearby districts) of Rajasthan state in India. Later, it was experimented with a new stem holder and a contactless sensor to improve the vibration of the device and the inconvenience of replacing the mechanical switch frequently. As a result, there is overall improvement in the performance of the device.**

**Keywords:** Holy Basil (Tulasi), women empowerment, contactless sensor.

## Introduction

WHILE international research focuses on the products manufactured in the organized sectors (e.g. automobile, pharmaceutical companies and others), the production activities conducted in unorganized sectors (e.g. the improvement of the processes and devices in the handicrafts and similar sectors) are generally ignored. Because of the significant investment (mainly, by private companies) and glamour attached to the former type of research and development, young researchers or engineers are easily attracted to research on this type of manufacturing. Hence, the knowledge domain is enriched year after year. On the other hand, attention towards other types of manufacturing activity is minimal. Even though several organizations and researchers from universities worldwide take up such research activities, either out of their passion or as a part of the Corporate Social Responsibility (CSR), they are handicapped with a very different set of criteria for the improved designs. For example, as pointed out by Fischer<sup>1</sup>, a designer is tempted to design devices for the poor that will save them time and labour. However, the poor have both time and labour in abundance. Unless they have a way to make money, they are unlikely to invest in such designs, irrespective of all the benefits that are typically promoted in the new design. This aspect was

addressed during the development of a device to manufacture spherical beads from the Holy Basil (Tulasi) plant. The technological improvement provided to the device to manufacture the beads from the stems of Holy Basil (Tulasi) has enhanced the earning of women who were engaged in making the garlands from the beads of Holy Basil (Tulasi).

## Current practices

Traditionally, spherical beads made from the Holy Basil (Tulasi) plant are produced manually<sup>2</sup> to make garlands. These garlands are either offered to the deity or used by the devotees in large numbers. In the villages of Brij area (Mathura, Brindavan and nearby villages) in Rajasthan, India, these beads are made in a semi-mechanized way, shown in Figure 1. This is mainly due to the high demand from patrons of the temples of Mathura and Brindavan. Many women (400–500) are engaged in making these beads from the stems/twigs of Tulasi to earn their livelihood. A Bharatpur-based NGO (Lupin Human Welfare and Research Foundation)<sup>3</sup> created several Self-Help Groups (SHGs) comprising of these women bead makers living in 18 villages of Bharatpur district. To make Tulasi beads, these women use a wooden structure to support one end of the stem, shown in Figure 1, while holding the other end in a hollow-shaped bent sheet connected to a DC motor running at about 1500–1800 rpm or more. The motor connects to a 12 V DC battery. The motor is carried by the operator (Figure 1). While a tool is used to peel off the shell of the stem and make a spherical shape by turning the tool carrying hand in an arc. A hole is automatically made in the bead, as it is supported on a sharp needle-like tailstock. However, this method is not very productive. Using this method, a worker can make about 30 garlands in 7–8 h per day which fetch them about INR 300–400 per day. Though these workers can make a living, they face several challenges. For example, in order to separate the bead from the stem, each time a bead is made, the workers make use of their fingers to stop the shaft of the DC motor. This process causes irritation and pain in their arm.

To address this problem, the Rural Technology Action Group (RuTAG) at IIT Delhi studied it and identified the

\*For correspondence. (e-mail: saha@mech.iitd.ac.in)

key issues that directly affect the productivity. Based on an ergonomic study, following areas were identified that required immediate attention:

- To make an arrangement or a provision to replace the need of motor being carried by hand.
- To devise a mechanism enabling the motor to stop without making use of fingers.

Several alternatives were proposed concerning the modification of the device described above. These alternatives were presented in a conference in IISc, Bangalore<sup>4</sup>, along with the final prototype that was fabricated and demonstrated to the SHGs in Bharatpur.

### Improved design by IIT Delhi

Once the problems faced by the women were explained to the team of RuTAG IIT Delhi, the first task was to study the operations carefully. Possible solutions were identified keeping in mind several attributes like: (i) keeping the cost minimal or no additional cost while making modifications, (ii) making minimal changes to the design of the device so as to retain usage habit (important from a psychological acceptance point of view). The proposed solutions were based on the answers to the questions on how can the women avoid using their hands to stop the motors, and how can the operators avoid carrying the motors. Several ideas were generated based on the answers stated above.

To model the final device for making the beads from the stems, its components (i.e. wooden frame with tail-stock support, tool guide platform, motor platform support, motor platform rod, DC motor, motor base, on-off switch and others) were modeled in Autodesk Inventor 2012. The assembly of the device for making Tulasi

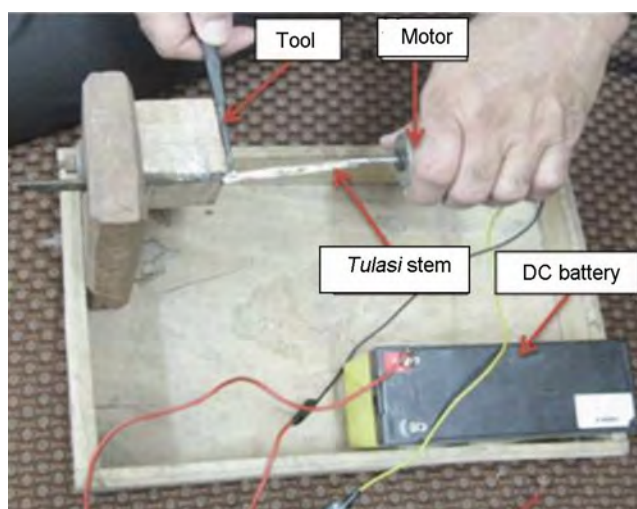


Figure 1. Existing device for making beads.

beads was also modelled in Autodesk Inventor 2012 before the final prototype was made. It is shown in Figure 2. The existing 1-amp DC motor was randomly selected without any technical consideration. When the motor was tested, it was observed that only thin stems could be used to make smaller beads and it was not fit for making bigger beads from the thicker stems. Hence, the motor was replaced by a 2-amp DC motor. But while testing the 2-amp motor, we observed that it worked well for making medium-sized beads, and not bigger beads. We then tested a 3-amp DC motor for making beads of bigger sizes. It worked smoothly without any trouble. Hence, this motor was recommended, since it could make beads of all sizes. An isometric view of the DC motor with the stem holder is shown in Figure 3.

Feedback on this tweaked design was then collected from at least 10 users through the NGO. The users were very happy with the modified device. They told us that they operated this improved device for up to 12 h in a day without getting tired. With this small design change, the

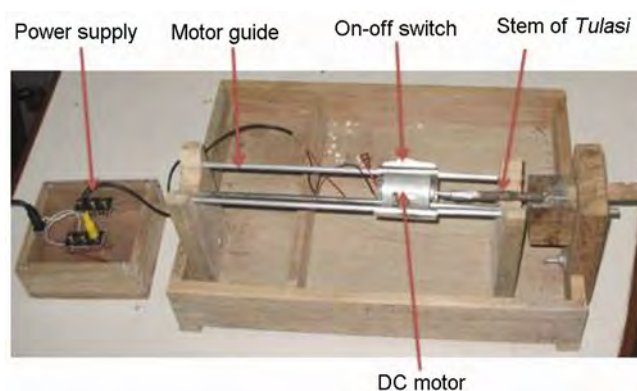


Figure 2. Improved device of IIT Delhi for making beads.

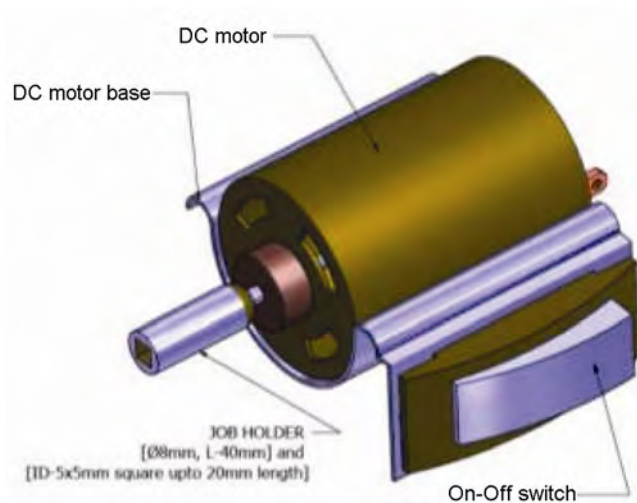


Figure 3. CAD model of the DC motor with the switch and stem holder.

workers can now earn about INR 800–900 per day (at least a two-fold increase over previous earning) by spending 7–8 h per day and INR 1200–1400 per day (three-four fold increase) if they work for 12 h in a day. This improved device is now being manufactured by a village carpenter in Nadbai village of Bharatpur; he sells it for INR 2500 per piece. A news report on the improved device also appeared in the daily newspaper, *The Hindu* on 7 September 2013 (ref. 5) (Figure 4).

**Further improvement**

Based on the continuous feedbacks received from the users, following modifications were carried out at IIT Delhi, soon to be sent for field trial.

*A new stem holder*

In the old design, a tapered square hole holder was provided to hold the stem of the Tulasi and the other side was push-fitted to the motor shaft without any locking device (Figure 3). To make this holder, tapered square punch was used which causes eccentricity, vibration, misalignment; and sometimes, it slipped too. Since it is difficult to machine a square tapered hole, a cheap electro

discharge machining (EDM) process was identified. A copper electrode for the EDM process was developed using a computer numerical controlled (CNC) wire cut machine. To lock the stem holder with the motor shaft, two grub screws were provided opposite to each other at the rear end of the stem holder, shown in Figure 5.

*Contactless switch*

Users pointed out that the life of the 5-amp on-off electrical switch (Figure 3) to start and stop the DC motor was short and had to be replaced every 4–5 weeks which is not only was inconvenient but also added to the recurring cost of the device. To address this issue, an electronic contactless switch based on infrared (IR) sensor was considered, illustrated in Figure 6. The IR sensor is a general purpose proximity sensor. The module consists of an IR emitter and high-precision IR receiver (Figure 7). An on-board LED indicator helps the user to check the status of the sensor (high output when IR frequency is high and vice-versa) without using any additional hardware. The power consumption of this module is low (10–12 W) and gives a digital output which goes to the H-bridge (driver) of the DC motor that runs according to the input of the IR sensor. The schematic diagram of the information flow is shown in Figure 7.

When an obstacle (the palm of the user) is encountered, the output of the IR receiver goes high. It drives the output of the comparator high, which is connected to the cathode of the LED to turn it on. The same signal goes to motor driver circuit, thus starting the motor. Figure 8a shows the position of the fingers before the start of the motor or to stop it, whereas Figure 8b show the fingers



Figure 4. Newspaper clip of the improved device (*The Hindu*, 7 September 2013).

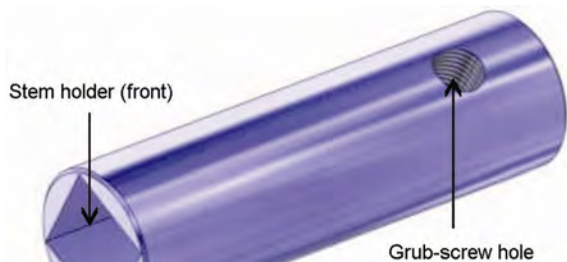


Figure 5. CAD drawing of the stem holder.

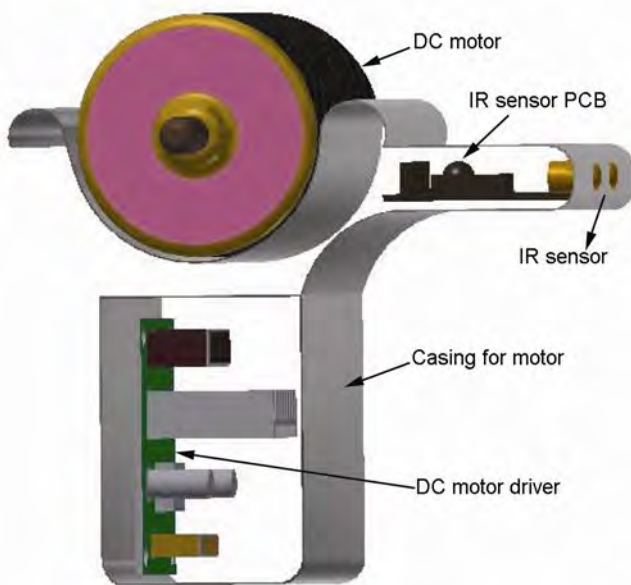


Figure 6. CAD drawing of the motor with IR-based contactless switch.



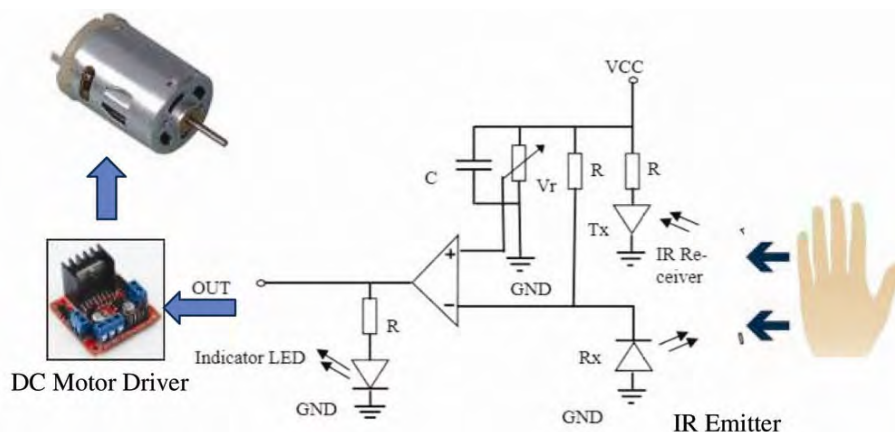


Figure 7. Information flow for the DC motor control by IR sensor.

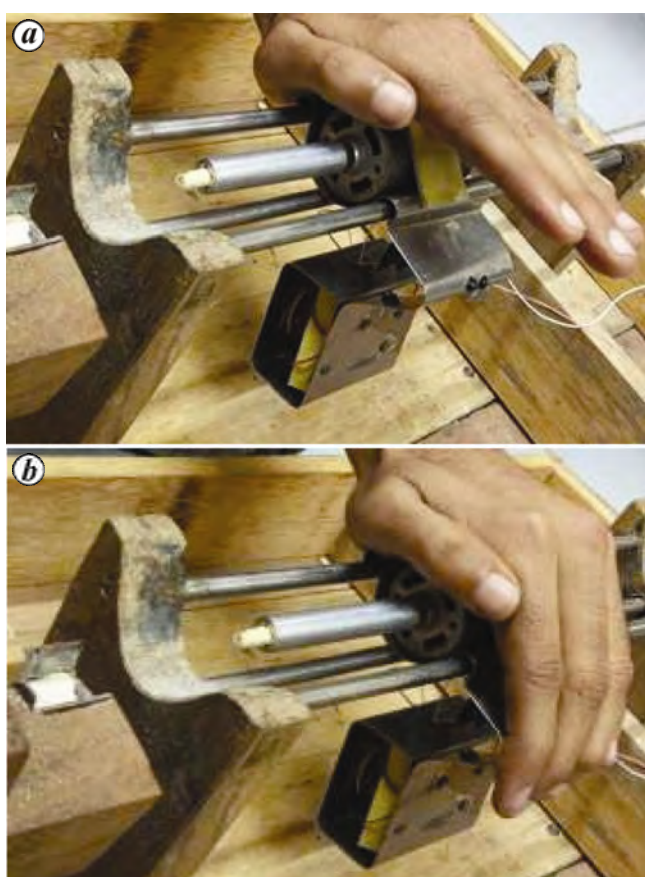


Figure 8. Functioning of the contactless sensor. *a*, Position of the fingers before starting the motor; *b*, Position of the fingers to start the motor.

position to start the motor before pushing it towards the tail support.

## Discussion

To improve ergonomics and productivity, a need was felt to improve a bead making device using Tulasi sticks. Such need based improvement in the design can be referred to as need driven design improvement (NDDI),

which effectively starts with being aware of the needs of the poor before attempting the solutions. In fact, 90% of the populations in the world belong to such groups who live below the poverty line (BPL). Designs for such people do not follow the same principles and strategies as one would expect for the products designed for the rich, for example, cars, washing machines and others. We mentioned earlier how these people do not invest in new designs and products unless they make money. In our case, modified design not only increased the productivity but also allowed workers, especially women to work for long hours with enhanced earning. Each woman could now make 80 garlands (compared to 30 using old design) from small beads by working only 7–8 h per day. It also provided each woman to work for longer hours (even up to 12 h) with enhanced earnings of about INR 1200–1400 (about three times more than what was earned).

It is worthwhile to mention here that RuTAG cells in seven IITs is supported by the Office of the Principal Scientific Advisor (PSA) to the Government of India. In the past few years, it has worked on several projects that have had an impact on the society. The projects of RuTAG are listed on its website<sup>6</sup>. The work on Treadle Pump<sup>6</sup>, for example is another project which was undertaken by RuTAG. In this project the washers used in the cylinder bore of the pumps and the levers on which feet are placed for the pumping action were improved.

It is to be noted that only technical interventions may not always empower the women<sup>7</sup>, it will be really worth to study in future that how truly these women of the Brij area of Rajasthan were empowered. This will of course require some appropriate indices taken from the domain of economics and perform surveys. We will report such analyses in our future publications.

## Conclusions

In this article, an improved device to make beads from the stems/twigs of Tulasi is presented which enhanced the

productivity and earnings of the women operators as well as improved their working conditions. The improved device has been successfully adopted by a local manufacturer to ensure its supply to users. The manufacturer has already sold 72 units priced at INR 2500–3000 per piece. Based on the feedback received from users on the improved design; two more changes: the stem holder and the contactless sensor were introduced. While the former improved the vibration of the device the latter enhanced the life of the switch with at a marginal additional cost (about INR 500) in the cost of the device. This additional cost connected to contactless sensor will be recovered over prolonged use of the device as it will minimize frequent replacements of the mechanical switches.

Finally, the aspect of the empowerment is assumed to have enhanced based on the increased earnings but in terms of real economic measures it is yet to be validated. It will be taken up in future as a follow-up project.

- 
1. Fischer, M., Design to Kickstart incomes. *Design for the other 90%*, Smithsonian Cooper-Hewitt, National Design Museum, New York, 2007.

2. How to make Tulasi beads? 2012; <https://www.youtube.com/watch?v=TuekS3bgv4A> (accessed on 18 August 2014).
3. Lupin Foundation–Sindhudurg, 2014; <http://sindhudurga.lupinfoundation.in/content/rural-industries> (accessed on 18 August 2014).
4. Gupta, R., Sharma, M., Saha, S. K., Prasad, R., Gaur, R. R. and Singh, J., Interventions for the empowerment of rural women: a case study of the manufacturing of beads from Holy Basil (Tulasi). In *Design for Sustainable Well-being and Women Empowerment*, Indo-Dutch International Conference on Design, IISc, Bangalore, 12–14 July 2014.
5. Holy Technology, *The Hindu*, 7 September 2013; <http://www.thehindu.com/news/national/holy-technology/article5103492.ece> (accessed on 18 August 2014).
6. RuTAG: Rural Technology Action Group, IIT Delhi, 2015; <http://rutag.iitd.ac.in> (accessed on 20 January 2015).
7. Duflo, E., Women empowerment and economic development. *J. Econ. Lit.*, 2012, **50**(4), 1051–1079; <http://dx.doi.org/10.1257/jel.50.4.1051>.

ACKNOWLEDGEMENTS. We thank the Office of the Principal Scientific Advisor to the Government of India for their support to RuTAG. We also thank the Director and staff of Lupin Human Welfare and Research Foundation, Bharatpur, Rajasthan for their inputs and feedback concerning the improvement of the device.

doi: 10.18520/v109/i9/1660-1664