iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VI **Month of publication:** June 2020

DOI: http://doi.org/10.22214/ijraset.2020.6031

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

"Autonomous Agriculture robot – AGROBOT SRISHTI"

Devashis Debnath
Mechanical & Automation Engineering, Amity School of Engineering and Technology, Mumbai, Amity University Mumbai

Abstract: Concerns over the production of good quality & quantity has been always raised in recent years. The exponentially growing human population, with lesser agriculture resources, made us seek new ways to improve agriculture efficiency. This problem can be solved efficiently using robotics, this in turn has increased the interest and spending, in Agriculture Robotics. Agricultural robot or "Agrobots" are a kind of robot which is used for reducing the labour cost, time and to increase the productivity, quality of the crop. This paper proposes a new type of Autonomous agriculture bot named "SRISHTI" for different uses in the areas of agriculture. The paper also talks about the future scope of agriculture robots especially in developing countries. There are already number of agriculture robot available, but they remain as experiment only and are not implemented on larger scale. This paper also investigates about the possible reason for such case, this paper will focus on the practical feasibility of the agriculture robots. After comparing different types of agriculture robot, it is concluded that practically feasibility of the agriculture robot not only just depends upon the type of technology used, but also depends upon the adaptability of the bot to the surrounding or to the infrastructure.

I. INTRODUCTION

India being an agriculture-based country, according to the agriculture census of India 62% of the Indian population are dependent on agriculture. The globalization in agriculture is less as compared to other countries. Agriculture plays as the basis of life as it provides us with food, fodder and fuel. The idea of maintaining agricultural environments by smart machines is not new concept, as it provides us good quality and quantity of agriculture products in a small span of time. Engineers have already developed driverless tractors although this can't replace by human operated tractors as this is something which need human assistance. The basic motive behind developing an Agricultural Automation robot is to decreasing labour force, the need for improved food quality. The agricultural bot mainly focuses on the basic problems faced by farmers. i.e. real time quality monitoring of the crop, ploughing, seeding, harvesting, spraying and fruit picking etc. Table1 Depicts the comparison of manual sowing techniques that requires more time and man power than sowing with tractor and Agriculture robot. This comparison tells us the use of robots reduce the time and also make the process more efficient This paper presents the initial step of autonomous agricultural robot. Followed by later stages, of addition of special abilities to robot such as monitoring crop status or weeding for taking sample from field, ploughing, planting and harvesting crops from fields.

Sr no.	Parameter	Manual	Tractor	Robot
1	Linear seed distancing	Not accurate	Not accurate	Accurate & precise
2	Time	More	less	Less
3	Pollution	No	Yes	No
4	Cost per sq. feet	Moderate	High	Less
5	Man-power	More	Moderate	Less
6	Seed wastage	Less	High	Less

Table 1 Comparison of sowing practices

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

II. LITERATURE REVIEW

A. Praveen Kumar Singh, Gaurav S Nikam, Rupali S Kad, [2015], In this research paper author has focused on the water resource management, conservation and watering of the crop in appropriate manner with exact quantity, which is kept in control using soil moisture sensor. The paper proposed an ARM 7 based Automated Robot which can be used to overcome the problematic issues of farming. This has been used as base for our research and further production of Autonomous multifunctional agricultural robot.

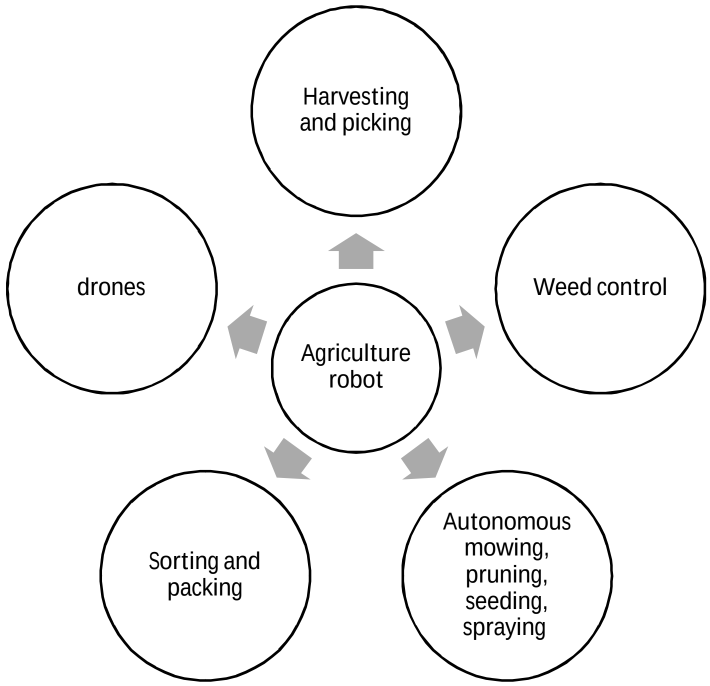


Figure 1. Types of Agricultcher Robots

B. D. Durai Kumar, C. Vijaya, S. Jayashree Janani, [2015], In this research paper author has focused on the very common problem of weeds in the agricultural field. The paper proposed a discrete wavelet analysis of the plants using MATLAB. In this proposed idea a 95.89% accuracy can be achieved. Which made us to take this idea in consideration while designing the robot.

C. A. Keerthana , P. Kirubaharan, S. Krishnamoorthy , K. Rajeswari , Mr. G. Syed Zabiyullah [2018] In this paper the author talks about the problem arise during Seeding and Forming. They proposed a LPC2148 microcontroller base robot which enables efficient seed sowing at optimal depth and at optimal distances. This result is considered during our research.

D. F.A. Adamu, B. G. Jahun and B. Babangida [2014] In this paper the authors have pointed out the importance of the performance factor of a power tiller. The requirement for light weight power tiller was put forward. Fuel efficiency and field capacity were also some of the important parameters which was discussed. those points were taken in consideration while designing the multifunctional agricultural vehicle.

III. EXISTING SYSTEM AND THEIR DRAWBACKS

Existing agricultural systems depends upon the interaction of human for the processes like ploughing, seeding, harvesting, spraying and fruit picking. The tractors truncate the soil, which is operated by human. Further some driverless tractors are developed also, but their actual feasibility in real scenario is very less. As being a heavy machine, we can't rely on automation as there are many other factors which needed to take care at the same time. Also, there are some automatic irrigation system has been implemented to reduce human work load. But these methods can't recognize the yield and soil type in vicinity. Further in order to provide solution to these problems many agricultural robots idea have been proposed by researchers. The problem with these robots is their feasibility and practical applications. Till date only 5% of the proposed robot ideas are actually getting converted into products which are available in the market for the commercial use. The Demand of such robots are high but the quantity of production is lesser which make the available robots expensive, and hence economically tougher for the poor farmers to have one machinery.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

IV. METHODOLOGY

A. *Design Criteria*

Six major factors were kept in mind while designing the Robot. These factors are as follow:

1) *Modularity:* It's important for the robot to be adaptive in order do multiple tasks, i.e., it should be able to add and remove different tools or units depending upon the type of operation. These tools or units can be robot arms, sprayers, weeding tools or various equipment which used in agricultural field.
2) *Cost to the Consumer:* Even though there are plenty of robots are available in the market, they tend to be expensive hence making it nearly impossible for the small-scale farmers to use the same. So, the robot must be economically feasible.
3) *Stability and Reusability:* The Agriculture Robot needs to move off road and should be able to pass over small obstacles in order to have a smooth path of journey. Additionally, it should be reusable i.e. change in some settings can make the robot do some other functions.
4) *Easy Interface:* The most of the small-scale framers being illiterate its very important to have a user-friendly interface to communicate and control the robot.
5) *Compact and Mobile:* the robot must be compact and mobile so that it can be easily carried to different places unlike the autonomous tractors which is bulky.
6) *Less Power Consumption:* The most of the rural area, specially where agriculture practices are done, the availability of power source is limited so a more power efficient robot is what we intend to make.

B. *System Overview*

The Autonomous Agriculture Robot SRISHTI's system consists of station computer, and the robot itself. Station computer is basically used for providing the robot data for its functioning and receiving the results. The Station computer can be an android phone, laptop or desktop in which the app is installed. For ease of use and as many people might doesn't have access to a smart phone, a laptop or a desktop the robot can be even controlled via SMS in case of the customer have a beta type phone. In plain fields or field rows, the bot uses GPS to find its position. Image processing is used to detect any kind of plant disease using mat lab. A delta robot based Robotic Arm is used for plucking weeds, fruits, spraying of pesticide. Pneumatic cylinder drills are used for sowing of the seeds.

V. DESIGN

A. *Rocker Bogie Mechanism*

1) *Selection of Motor*

Total load on robot = 30N

Power required by the robot to carry a load is given by –

$$P = W \times v$$

Where,

W = load

v = velocity

$$P = 30 \times 0.15$$

$$P = 4.5\, watts$$

In worst case of failure only one motor might have to provide the total power. Hence motor of power rating 4.5 watts has been selected. Total power required to drive 6 such motors is,

$$P_{required} = 6 \times 4.5$$

$$\boxed{P_{required} = 27\, watts}$$

So, 6 dc motor of 4.5 watts, running on 12v ,1-amp current at an RPM of 40 is selected.

2) *Selection of Battery*

A lithium polymer battery of 12V, 3Ah is used, which will provide 36 watt-hours of power.i.e.

$$\boxed{P_{provided} = 36\, watt\ hours}$$

$$P_{provided} > P_{required}$$

So, this battery can be used.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

3) Design of Wheels

Assuming the required speed 15cm/s i.e. 150mm/s.

We know that**,**

$$\boldsymbol{V = \frac{\pi D N}{60}}$$

Where, V= Velocity

D = Diameter of the wheel

N= RPM

The rpm of the motor used is 45 rpm

$$150 = \frac{\pi D N}{60}$$

Which gives us,

$$D = 65mm$$

Therefore, a wheel of 65mm diameter is used.

4) Design of Linkage

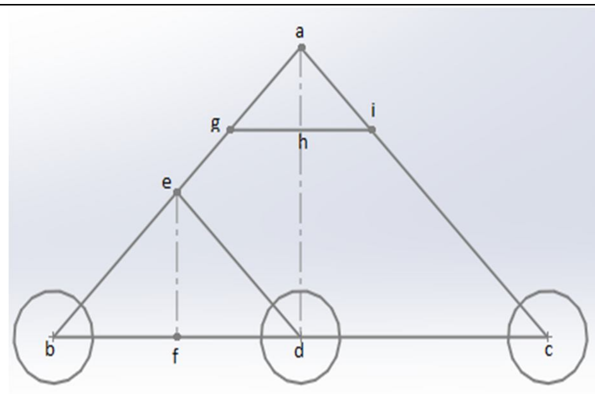


Figure 2. Linkage system of rocker bogie

$$total\ length\ of\ the\ bot = wheel\ base + 2 * wheel\ radius$$

Wheel base of the robot = 500 mm

Radius of the wheel = 32.5 mm

Total length of the bot = 565 mm.

In Δabc,

$$\angle bac = 90°$$
$$\angle abc = \angle acb$$
$$ab = ac$$

In Δadb & Δadc,

$$ab = ac$$
$$ad = da$$
$$\angle adb = \angle adc$$

Therefore,

$$\Delta adb \equiv \Delta adc$$

$$bd = dc$$

Also,

$$bc = 500\ mm$$

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Therefore,

$$bd = dc = 250\,mm$$

In Δadc,

$$\angle dac = \angle dca$$

Therefore,

$$ad = dc$$

$$\angle adc = 90°$$

Using Pythagoras theorem,

$$da^2 + dc^2 = ac^2$$

$\because \quad ad = dc$

$$2dc^2 = ac^2$$

$$ac = \sqrt{2}(250)^2$$

$$ac = 353.55\,mm$$

Rounding off

$$ac = 355\,mm$$

Now using ac = 355 mm

We have,

dc = 251 mm

which gives us,

$$\boxed{New\ wheel\ base = 502\,mm}$$

And,

$$\boxed{Final\ total\ length = 567mm}$$

Now,

In Δefd,

Using Pythagoras theorem,

$$ef^2 + fd^2 = ed^2$$

$$ed = 177.5\,mm$$

Also, from Δahg & Δadb

$$\frac{gh}{bd} = \frac{ah}{ad}$$

Which gives

$$ah = 100\,mm$$

This gives the final height of the bot = 151+32.5

Final height of the robot = 183.5 mm

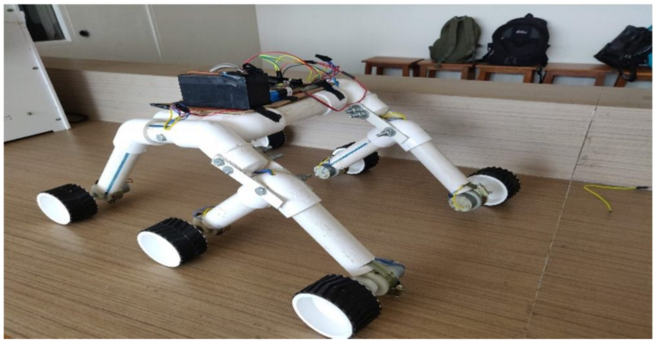


Figure 3. Rocker Bogie system

5) *Electronics Component*

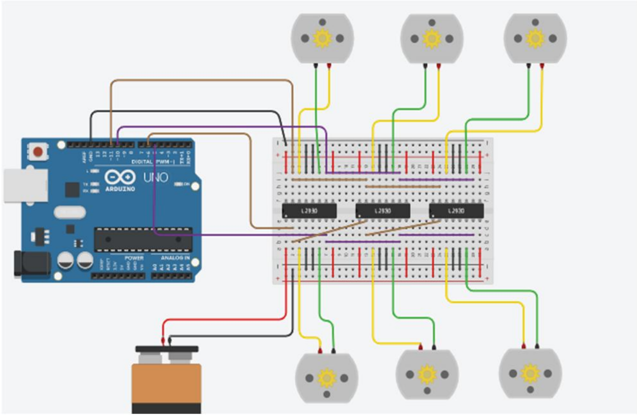


Figure 4. Wiring diagram of rocker bogie

B. Design of Delta Robot

1) Base radius(f) = 200 mm.
2) Bicep Length(rf)= 80 mm.
3) Forearm length(re)= 150mm.
4) End Effector Radius(e)= 25 mm.
5) Base to floor Distance(b)= 200mm.
6) Steps per turn (motor) = 3200
7) Rectangular cuboid envelope: -
a) *X= -60.825 to 60.825 mm*
b) *Y= -60.825 to 60.825 mm*
c) *Z=* -185.053 to -63.403 mm

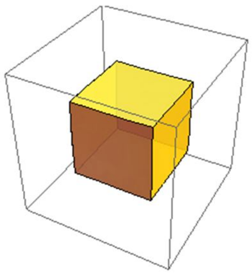


Figure 5. Workspace of the robot.

Volume covered = $1.80026 \times 10^6 mm^3$

8) Motor angle limits
a) Theta 1 = -62.85 to 113.31
b) Theta 2 = -85.27 to 269.09
c) Theta 3 = -85.27 to 269.09
9) Centre = (0,0, -124.228)
10) Home = (0,0, -73.926)
11) Resolution = +/- 0.059mm
12) Electronics Component

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

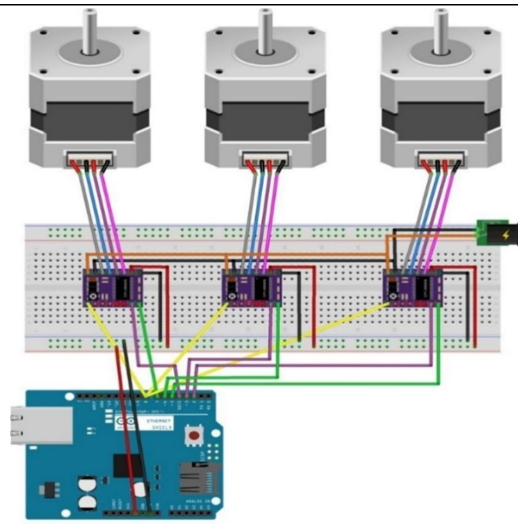


Figure 6. Wiring diagram of delta bot

VI. BLOCK DIAGRAM

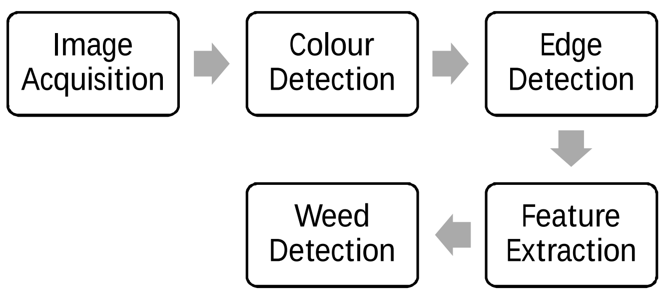


Figure 7. Block diagram

VII. ALGORITHM IMPLEMENTATION

A. Weed Detection

1) Step 1. Sample image collection

The first step is acquisition of the frame. here we have used a top view image of a crop felid in day light. This image is used for further image processing and leading to weed detection. `

Figure 8. Sample Image

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

2) *Step 2.* Masking the image (i.e. eliminating the background)

The next step is to remove background of the image in order to preform colour detection. I order to do so; we need to adjust the HSV values which are specific for each colour. Masking is the process used to setup the required HSV values, which help us to obtain the required coloured part. HSV ranges from 0-255, 0-360 in general. The OpenCV takes half the original HSV value i.e. 0-180. we adjust the HSV value such that we just obtain the green coloured part leaving the unnecessary soli part behind.

Figure 9. Masked Image

3) *Step 3.* Colour detection

The next step is colour detection, the main air of this process to determine any defect in leaf such as some leaf disease. in this case we have the weeds and the crop leaves green in colour. In these cases, the colour detection is not sufficient to differentiate between weed and the crop plant and so we proceed to the next step i.e. Edge Detection.

Figure 10. Image after colour detection.

4) *Step 4.* Gaussian blur

Before passing the image through the edge detection algorithm it is important to remove all

Figure 11. Blurred Image

King of noises presents in the image; this is done using Gaussian blur method of image blurring. Gaussian blur is an image blurring filter which can be used in one or more dimensions. The Gaussian blur filter not only just remove the noise present, but also make the image smooth.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

5) Step 5. Edge detection

Followed by the removal of the noise of the image using the Gaussian blur filter, the Laplacian filter of edge detection is used for the edge detection of image. Edge detection is used to find the boundaries of the leaf as well as of the weed. The Edge detection detects the discontinuities in the brightness of the image provided which makes the edge of the objects present.

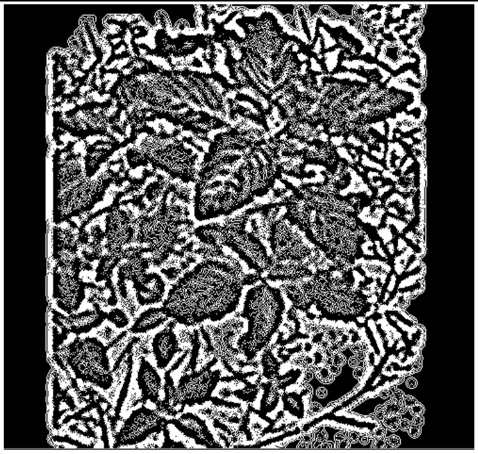


Figure 12. Image after edge detection.

6) Step 5. RGB to Gray conversion

The next step is to convert the coloured image into Gray scale. i.e. converting the image from 3d matrix to a 2d matrix.

Figure 13. Image after RGB to Gray conversion.

7) Step 6. Thresholding

It is the major step in this process. It is the simplest way of the image segmentation which creates binary images. To attain high efficiency Thresholding is done only in the Gray images. adaptive threshold method is uses for the thresholding of the image.

Figure 14. Image after using adaptive threshold method

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

8) Step 8. Feature extraction

Figure 15. Feature extracted Image.

The final step and crucial too. Here the feature extraction is done in order to weed detection.

Figure 16. image after weed detection

The ORB (Oriented FAST Rotated BRIEF) algorithm is used for the feature extraction. It computes the intensity centroid. These centroids are used to compute the Imaginary rectangle coordinates which is further used by the delta robot.

B. Weed Pick/ Spraying Pestiside

The weed detection algorithm provides the coordinates of the region of the weed detected is passed to the delta robot in form of X, Y, Z coordinates, which moves the delta robot and felicitate in its action of weed removal or spraying of pesticide.

VIII. RESULTS

The sample image and the detected image is as follow:

Figure 17. Sample image taken with weed leaves

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VI June 2020- Available at www.ijraset.com

Figure 18. Image after weed detection

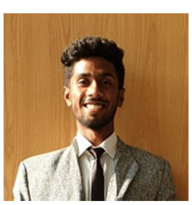
IX. CONCLUSION

This method of weed detection and removal has shown high accuracy considering various other important parameters such as texture, genes, etc. Removal of weed is an important factor to look after for a good crop. This robot because of its adaptability to different situation and user-friendly can be ideal to be used in rural areas. The proposed system acts both accurately and efficiently in real scenario.

REFERENCE

[1] D.Durai Kumar, C.Vijaya, S.Jayashree Janani "Autonomous navigation of mobile robot for automatic weed detection and herbicide spraying in agriculture", Published in: international journal of engineering sciences & research Technology 4(3): March, 2015
[2] Praveen Kumar Singh, Gaurav S Nikam, Rupali S Kad, "Automation in agriculture field using arm 7 based robot" published in International Journal of Research in Engineering and Technology Volume: 04 Issue: 04 | Apr-2015
[3] Mehmetcan Güleçi, Murat Orhun, "Android based WI-FI controlled robot using Raspberry Pi", Published in: 2017 International Conference on Computer Science and Engineering (UBMK), 5-8 Oct. 2017.
[4] A.Keerthana , P.Kirubaharan, S.Krishnamoorthy , K.Rajeswari , Mr. G. Syed Zabiyullah [2018] "Agriculture Robot for Seeding and Forming" published in International Research Journal of Engineering and Technology Volume: 05 Issue: 05 | May-2018
[5] Dogan, E. (2010). Calculations of Delta Parallel Robots Forward and Inverse Kinematics. Conference on Eskisehir Osmangazi University. 61-65.
[6] J.C.Dixon, Tires, Suspension and Handling Second Edition, Society of Automotive Engineers, Arnold London, 1996
[7] Merlet, J. P. (2006). Jacobian, manipulability, condition number, and accuracy of parallel robots. Journal of Mechanical Design. 128(1):199-20.
[8] M. J. Uddin, S. Refaat, S. Nahavandi and H. Trinh, "Kinematic Modelling of a Robotic Head with Linear Motors," Deakin University, School of Engineering and Technology, Geelong.

BIOGRAPHIES



Devashis Debnath, He is pursuing his degree in BTech in Mechanical & Automation from Amity School of Engineering And Technology Mumbai , Amity University Mumbai .