IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

Study of Various Associate Skill Development Systems used in Automotive Manufacturing Industry

Arvind A R[1], Syam Chandrasekharan[2], Angelina Geetha[3]
Project Planning, Ashok Leyland, Ennore, Chennai, India[1]
Hindustan Institute of Technology and Science, Chennai, India[2,3]
ara.aravind@gmail.com, shyamc310@gmail.com, angelinag@hindustanuniv.ac.in

Abstract: *Automotive manufacturing is challenged with technology changes (Electric, Fuel cell, Hybrid, Diesel, Ethanol, Methanol), Cost pressure and macro-economic changes like CNG. In these changing scenario automotive industry grapples under pressure to produce varied model mixes to cater to customer requirements. These changes often result in large defects in manufacturing due to in-adequacy of associates training / skill development. The paper is focused to benchmark the best-in-class practices of automotive original equipment manufacturers globally towards human resource skill development for defect reduction, productivity enhancement and morale using modern Information technology tools and methods*

Keywords: Skill development, Training, Workforce Training, Job familiarization, Skill mapping, Operator allocation based on skill level

I. INTRODUCTION

Globally skill development is the key for manufacturing industries to be ahead in the race towards better profitability. Automotive manufacturing industries employ large workforce in their manufacturing facilities. These workforces are not only related to core manufacturing but also in other functions like quality, sales, service, human resources, finances, logistics and material planning to name a few.

School & College curriculum are restricted to theoretical knowledge with limited exposure to practical real-life scenarios. The skill sets needed to readily support manufacturing industries are not observed in the inducted freshers. Culture also plays a vital role for lateral entrants to be on boarded quickly.

The lack of needed skill set results in direct defect generation and rework in manufacturing lines, inefficiencies in other areas / functions of the manufacturing industry.The progress in technology has forced organizations to adapt to new business models and improve. Skills mapping identifies the tasks and requirements that need to be addressed by an organization. It is possible to determine employees who are most valuable and who are specialists in a number of ways. Consequently, organizations must create a skills map to determine whether their employees are good at what they are doing. Furthermore, skill mapping allows organizations to track the progress of their employees or teams.

This paper studies in detail about various skill development systems deployed globally by automotive manufacturing organizations with a focus to identify emerging trends and arrive at recommendations.

II. REVIEW OF LITERATURE

Eleonora et al. (2019) observes technological advancements, augmented reality becoming more popular with vide adoption in many industries including automotive industry. Augmented reality has evolved over the years in various sectors and industries are widely using augmented reality for the benefits it offers.

Esdras et al. **(2018)**describes the gamification learning and its support to industry 4.0 in particular to manufacturing industries by providing them with a learning environment. Further discusses on how gamification can be implemented in a sustainable manner to help manufacturing industry 4.0 or organizations overcome the difficulties they face while maintaining sustainability.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

Bashir et al. (2019) details the implementation of VR based training for improving industry 4.0 through Reconfigurable Manufacturing Systems (RMS) concepts. Students or new comers can understand manufacturing techniques in a safer and more cost-effective manner by using virtual reality technologies. Further presents method for utilizing virtual reality in manufacturing as a leading visualization approach.

Hosseinpour et al. (2009)recommends simulation-based training as a valuable tool for manufacturing industries more inclined towards testing of products. In an industrial application, this technology is cost-effective, safe, fast and can test / learn about the behavior of the system.

Heidrun et al. (2009) observed that classroom-based training enhances the students' focus on the related subject. Furthermore, it enlarges student-teacher interactions as well as student-student interactions.Classroom-based training puts employees in a supportive learning environment which improves their ability to learn.

Mohamad et al. (2016)explores effective use of lean manufacturing tool in production sector evaluating existing lean procedures thereby enabling improved decision-making.

Benjamin et al. (2020) explores the fundamentals of simulator-based training in different fields.This study describes the training of manufacturing employees, which is further analyzed using Human Machine Interface design to reduce the risks involved in real-life training.

Barbara et al. (2013) reviews the different training methods and identifies the nature and characteristics of these training methods. The methods observed are not very interactive and indicates technological advances have led to a variety of delivery options over distance.

Hooi et al. (2017) compares the Japanese automotive manufacturing industry with three other local automotive manufacturing industries and finds that Japan has improved both onjob training and offjob training compared with the other local manufacturing industries.

III. REQUIREMENT OF TRAINING

Based on the above literature study, training needs identified are towards addressing the following salient parameters.

- Standard operating procedure familiarization / adherence
- Varying product matrix
- Varying production requirements
- Varied skill matrix
- Topography differences
- Cultural differences
- Increased operational efficiency
- Improved morale
- Enhanced work satisfaction
- Better communication
- Improved problem solving
- Reduced fatigue
- Defect reduction
- Improved profitability

Organization builds training programs to cater to the varying needs of employees as cited above. The Positive learning experiences should drive the production line at all times. In order to become more effective and productive, employees must complete the training and to achieve, companies and organizations need to facilitate better quality employee training using modern learning / training tools. Prior to embarking on providing training, the present situation is accessed through Skill mapping.

Skills mapping shows all the skills of employees in a visual format, which is helpful in identifying a job role for that employee based on his/her skills or identifying their specialties.A matrix is created by writing all the information down that has been collected about each department, employee, and team, then listing the names based on the skills each one possesses in the matrix. Skill mapping helps to identify employee's weakness and strengths in the company. HR professional can identify skills which he/she possess. It also helps to identify weaker side of an employee or team.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

Organization can identify which skill are their employees lacking on. The study conducted by ***Swati et al(2014)*** shows there is an increase of 23% in employee efficiency and effectiveness and MIT College of Engineering, Pune have observed an increase in error free production of automotive components.

IV. CHALLENGES IN EMPLOYEE TRAINING

There are several challenges encountered while developing & deploying training among the workforce. Industry wide challenges are compiled and presented in table 1.

Table 1 : Challenges in Employee Training and Mitigation

S.No	CHALLENGE AREA	MITIGATION
1	Succession Planning	Employees gain experience Ensures that they achieve senior level positions Decision making is one of the key training requirements Planned training modules for lower-level entrants
2	Increasing Value	Developing new skills and improving existing ones Diverse skill sets allow for transfer to a better open position within the organization
3	Reduced Attrition	Employee attrition reduction through career paths mapping. This also saves recruitment costs since they won't have to look elsewhere for jobs.
4	Enhanced Efficiency	Improve the efficiency and effectiveness of organizations through workforce training
5	Exceeding Standards	Gain edge over competitors by teaching employees the industry-standard practices A knowledgeable and happy staff can improve interactions with customer Business differentiates from competition
6	Improvement in IT and computer skills	Computer skills and IT topics training programs Deeper understanding of computers for increased workplace productivity Training on creating graphs and spreadsheets
7	Improved and updated technology	Increase awareness of the latest technologies in order to increase efficiency and productivity, as technology is constantly changing Tracking employee knowledge before and after a training program to determine training effectiveness
8	Better workplace environment	Consistency in training leading to effective workplace environment Employee feed value factor generation
9	Boosted morale	Supportive workplace concept selling among employees Morale booster & self-confidence building programs
10	Reduced supervision	Employee motivation for reduced supervision
11	Reduced defects	Training employees on process and product quality requirement helps in defect rate reduction up to 48.8% (**Shyam *et al.* (2015)**)
12	Flexible working	Remote working can boost employee morale and reduce stress The ability to maintain a good work-life balance can lead to increased trust and commitment at work.
13	Quicker onboarding	New recruits develop a sense of familiarity with the organization, but they are not as productive as expected. Therefore, a smooth functioning organization relies heavily on the onboarding process. Prior to interviewing for jobs, students were given the survey as they left an orientation at the career center. Of the 1,000 surveys distributed, a total of 461 students (46%) completed the survey. Different factors were measured, including personal values, past work experience, and

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

		demographics. ***Kaylee et al.(2014)***
14	Skill mapping & gap reduction	Performance management software Development plan that goes beyond an annual appraisal Understanding the need for the learning journey
15	Bringing stability in someone's career	Progressive employee's career stabilization and transition to a valuable asset for the organization
16	Increase in Miscellaneous Expenses	Doing it Right the first time reduces time, materials, rework and cost Adopting lean manufacturing techniques training

V. MODERN TRAINING METHODS

The above challenges are mitigated through various training methods and modern training techniques are also deployed which are discussed as below.

i) Systematic Training

The goal of training is determining the skills of a particular employee, which can be done through a professional approach with the help of the line manager as well as Human Resources in a company. In order to train the person, the company must understand where they lack in.

ii) Information Specific to Employees

Information from a performance appraisal is used to identify the specific problems of employees and how they can be improved. The performance provides an assessment of the current and expected performance, identifying the underlying problems and developing a training and development program to improve the performance.

iii) Training in Career Planning and Development

Matching the skills of a person with the opportunities provided by a company is an important step in training for a career plan. Both the employer and the employee should do their part. Charts showing how the training methodology progresses could motivate employees. Charts play an important role in training.

iv) Work Experience Enrichment

A person's ability to develop is only triggered by the mismatch between their past experience and the skill that they possess. The majority of employee development takes place in the workplace. In order to be successful in their jobs, employees must enhance their skills. Rotation and enlargement of jobs are the best ways to improve employees' job experience. The company may also offer a promotion or transfer to improve the employee's experience if they feel the skill is valuable.

v) Improve relationships with others

Being in good terms with others is also a way to improve skills, technical knowledge, company knowledge and client interaction skills. Being able to have good relationships with others can enable a senior employee to share their experience with less experienced employees.

vi) Analyze the effectiveness of training

An analysis of the effectiveness of training helps us to identify the different learning outcomes and facilitates the planning of training interventions. Identifying or highlighting the employee's weak points can improve the training's effectiveness

vii) Virtual Reality (VR) Training

Virtual reality technology is used by Volkswagen and BMW to train their employees for assembly line work. Since virtual reality takes place in the virtual world, there is no need to worry about the risks associated with it (***Ford Media's 2020***). This is depicted below in figure 1.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

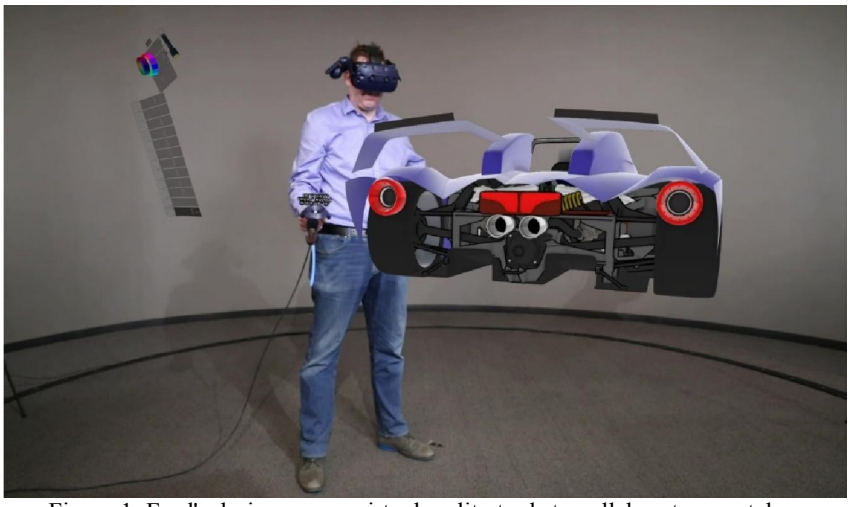

Figure 1: Ford's designers use virtual reality tools to collaborate remotely

Unlike other trainings, the training environment will be safe and effective. Training the employees on the assembly line for cars through virtual reality may improve their speed in that particular section. Consequently, virtual reality training lowers the risk of injury. Figure 2 is a sample screen of the virtual reality environment the training is offered.

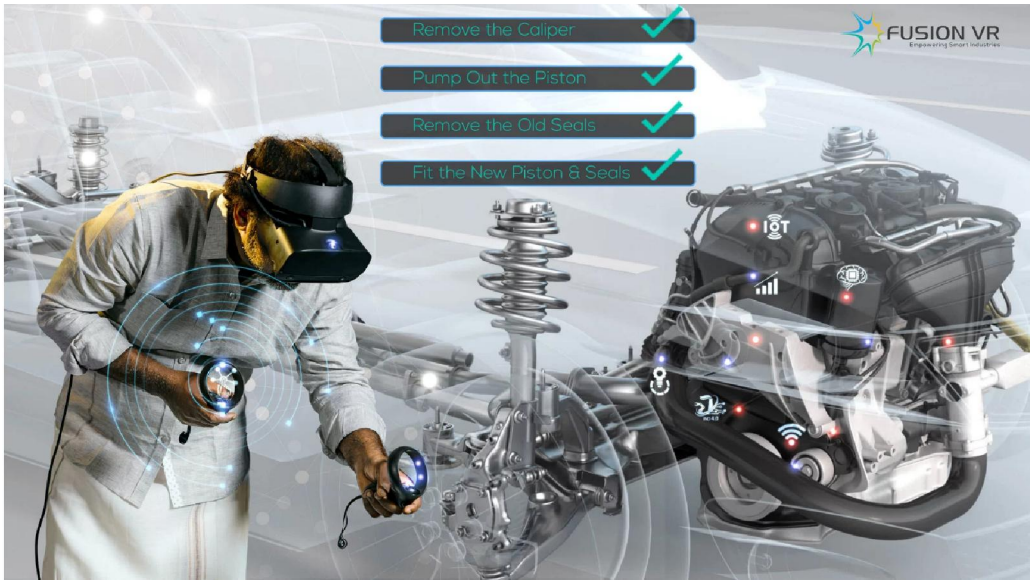

Figure 2: VR Training is used to Inspect Engines

Ford in their Ford World Headquarters located in Dearborn, MI, Virtual reality helped reduce employee injuries by 70% and improved assembly line speed.

viii) Augmented Reality (AR) Training

AR in inspection and testing, an AR-based system ensures unparalleled workshop efficiency by combining tracking, object recognition, and task-oriented user interfaces (***Utsav Patel 2020)***. Parts and components are identified through the interface. There are marked steps that guide the user to diagnose and resolve the issue. Figure 3 is a sample of the training supported by augmented reality, to identify different parts of a vehicle.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

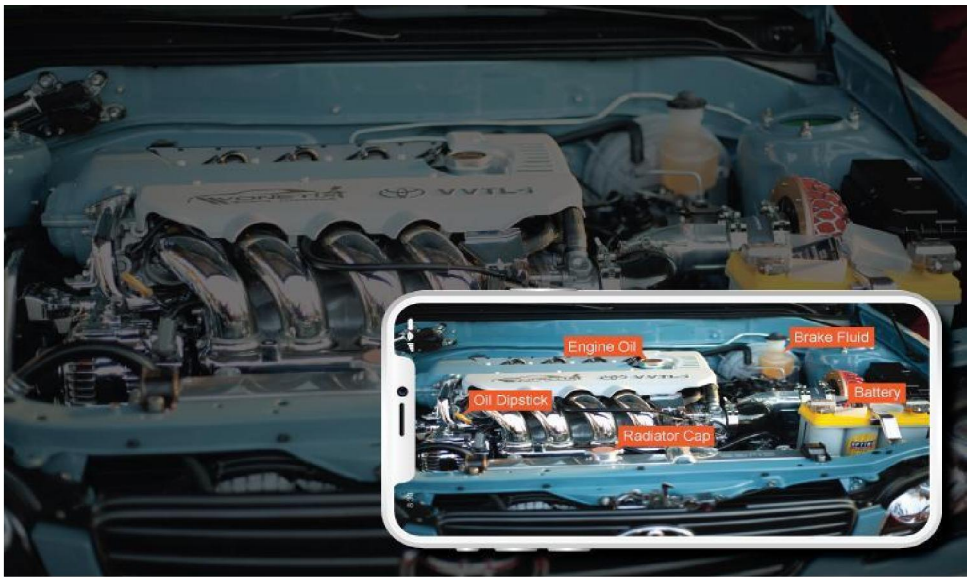

Figure 3: AR Training used to identify different parts of a vehicle

ix) Gamified Training

Since 2018, Audi has used gamified based training to train its employees. As part of this gamified training, employees are given funny or challenging situations to deal with(***Audi 2018)***. Virtual customers are also a part of this training system, and they have mood barometers which show the employee's actions that may trigger the customer, which can help the employee improve in the next playthrough. A depiction of this is given in Figure 4. Gamification is one of the best ways Audi can implement gamified training since it will help them better understand customers and their feedback.


Figure 4: New Gamification Concept used by Audi in Digital Car Dealership

x) Simulation-based Training

Through simulation-based training, organizations can train their employees in the area of automotive logistics according to the principle of cause and effect. This type of simulation-based training could help the employee adjust his/her skills and adjust the employee based on the market demands. Figure 5 depicts the broad level classification of training methods and industries adopting such trainings.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

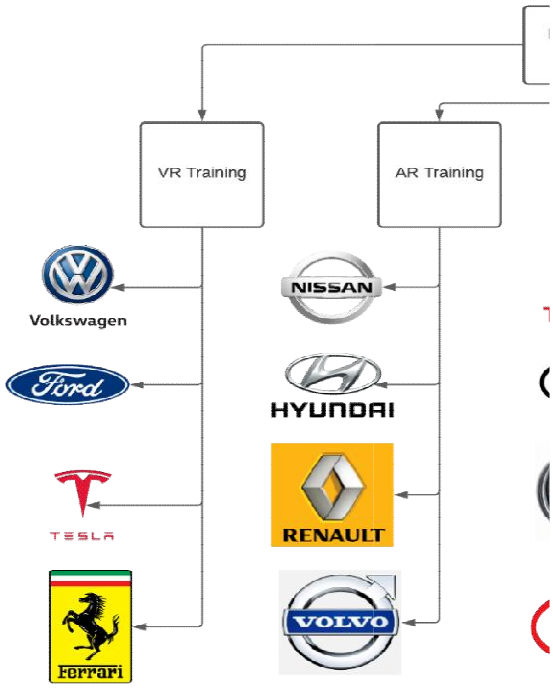

Figure 5: Classification of Training Methods adopted in Industries

The various advantages (pros) and drawbacks (Cons) of the training methods are studied and compiled as below in Table 2.

Table 2 : Advantages and Drawbacks of various Training Methods offered in Industries

Training types	Pros	Cons
Virtual Reality (VR) Training	Safe Learning Environment Technical Skills Practice in a Realistic Environment	Side effects (Motion Sickness, Eye Strain) The cost is high
Augmented Reality (AR) Training	Developing Soft Skills and Expertise Enhance the Effectiveness of Learning Materials	Situations that result in an accident Lack of privacy
Simulator Training	Learner friendly It can avoid danger and loss of life.	High maintenance cost Training and proper handling is required
Gamified Training	Fun and interactive Learning Provide Instant Feedback	Creates addiction High Cost of Development

VI. CONCLUSION AND RECOMMENDATIONS

Various types of training methods adopted in the automotive industry are compared, the challenges faced are listed and types of training documented using benchmarking technique. Technological advancements have created great opportunities for new training methods such as AR, VR, and Gamified training in the automotive industry. The paper has discussed different challenges faced by the automotive industry in implementing employee training. This paper also focused on different training methods adopted by the different automotive industry as well as their pros and cons. The adoption of the latest training methods and practices is imperative to our upcoming generations in the automobile industry.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 8, April 2024

REFERENCES

[1]. Esdras Paravizo, Omar Cheidde Chaim, Daniel Braatz, Bernd Muschard, Henrique Rozenfeld (2018), "Exploring Gamification to Support Manufacturing Education on industry 4.0 as an Enabler for Innovation and Sustainability", Elsevier Science Direct Procedia Manufacturing, Issue 21, 2018, pp 438-445.

[2]. EleonoraBottani& Giuseppe Vignali (2019), "Augmented Reality Technology in the Manufacturing Industry: A Review of the Last Decade", IISE Transactions, 51:3, 284-310, DOI: 10.1080/24725854.2018.1493244.

[3]. Salah B, Abidi MH, Mian SH, Krid M, Alkhalefah H, Abdo A. (2019), "Virtual Reality-Based Engineering Education to Enhance Manufacturing Sustainability in Industry", 4.0. Sustainability. 11(5):1477. https://doi.org/10.3390/su11051477

[4]. HosseinpourF. and H. Hajihosseini (2009),"Importance of Simulation in Manufacturing", International Journal of Economics and Management Engineering, Vol. 3, No. 3, pp. 229-232.

[5]. Stoeger, Heidrun and Ziegler, Albert. (2008), "Evaluation of a Classroom-basedTraining to Improve Self-Regulation in Time Management Tasks during Homework Activities with Fourth Graders", Journal of Metacognition and Learning, Issue 3. pp. 207-230.

[6]. Deepak Bankar and Kashilkar S. (2014), "Skill and Competency Mapping : A Tool for Training Need Identification Through Six Sigma", International Journal for Research in Emerging Science and Technology, 1(5), pp. 74-81.

[7]. Ahmad, M., Ting Neo,MuhdNor, Nik Hisyamudin, ChanShiau Wei, Hassan, Mohd. Fahruland Aziati A. (2017), "Comparative Study of Lean Practices between Japanese and Malaysia Automotive Service Centres", AIP Conference Proceedings, 1891(1).

[8]. "How Ford, Bosch Are Using Virtual Reality to Train Technicians On All-Electric Mustang Mach-E | Ford Media Center", (2020), Ford Motor Company Press Release, https://performance.ford.com/enthusiasts/media-room/2020/2/technicians-trained-for-mach-e.html.

[9]. "Why Augmented Reality-based Training is Vital for the Automotive Industry", SoftWeb Solutions, www.softwebsolutions.com/resources/AR-application-for-automotive-industry.html.

[10]. "Advantages and Disadvantages of Simulation Training", https://simulatedtraining.wordpress.com/advantages-disadvantages-of-using-simulation-training/

[11]. "Everything to know about Skill Mapping", https://www.ag5.com/everything-you-need-to-know-about-skills-mapping/

[12]. "Audi Virtual Training: Virtual Training for Sales Jobs", https://www.audi.com/en/career/working-world/gamification-audi-virtual-training.html

[13]. "Life in the Fast Lane: Training for the Automotive Industry", www.litmos.com/blog/articles/training-for-automotive-industry

[14]. A.Babukaruppiah and S.Kannadhasan, A Novel Approach to Detect the Shortest Path for Secure Data Aggregation Using Fuzzy Logic in Wireless Sensor Networks. International Journal of Engineering and Computer Science, Volume 2 Issue 3 February 2013, Page No.330-334, ISSN: 2319-7242

[15]. S.Kannadhasan and V.B.Bhapith, Research Issues on Digital Image Processing for Various Applications in this World. Global Journal of Advanced research, Volume 01, Issue 01, November 2014

[16]. S.Kannadhasan, R.Nagarajan and R.Banupriya, Performance Improvement of an Ultra wide band antenna using textile material with a PIN Diode, Textile Research Journal, DOI: 10.1177/00405175221089690 journals.sagepub.com/home/trj, Vol 92 (19-20) 3591-3606, April 2022

[17]. "How Ford, Bosch are using Virtual Reality to Train Technicians on All-Electric Mustang MACH-E", media.ford.com/content/fordmedia/fna/us/en/news/2020/02/14/ford-bosch-virtual-reality-technician-training-mustang-mach-e.html.