



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 9.935**

**Volume 15, Issue 5, May 2026**

# **Improving Construction Productivity with Automation and Intelligent Construction Technologies**

**Shital Raut, Dr.Ashish Waghmare, Dr.Gaurav Vispute**

Research Scholar, Ajinkya DY Patil School of Engineering, Pune, India

PG Co-Ordinator, Ajinkya DY Patil School of Engineering, Pune, India

Guide, Ajinkya DY Patil School of Engineering, Pune, India

**ABSTRACT:** As a growing trend toward automation, construction has advanced from the use of crude tools to machinery. Process automation and robotics can improve construction productivity, accuracy, and safety. On the other hand, structured prefabrication is growing in popularity worldwide as a way to increase productivity and lessen the environmental impact of conventional construction techniques. As a result of the integration and application of automation and prefabrication technologies, the construction sector may experience new advances. This study examines the use of automated technologies in structural prefabrication and construction, covering current advancements, problems, and future prospects. Design, construction management, robotic production, self-driving transportation, and automatic structural assembly are the five processes intended to follow the construction sequence. The paper concludes that widespread use of automation technology is preferable to structural prefabrication for construction, and that the design for robotic construction introduced through connection innovations may be beneficial as a means of avoiding complex operations and thus improving robotic assembly processes' efficiency. As a result, there are numerous equipment available in the construction sector that can be employed to boost work productivity while lowering labour costs and human effort. Automation in construction should be used more in India, where there is room for infrastructure growth.

**KEYWORDS:** Automation, construction industry, Infrastructure projects.

## **I. INTRODUCTION**

The Robot Industries Association (RIA) has defined an industrial robot as "a reprogrammable multi-functional manipulator designed to move material, parts, tools or specialized devices. A more general definition of a robot is: a general-purpose, reprogrammable machine capable of processing certain human characteristics such as judgment, reasoning, learning, and vision.

An intelligent robot is one that responds to changes to its environment through sensors connected to its controller. And one of the most important considerations in using a robot in a workplace is human safety. A robot equipped with sensory devices that detect the presence of an obstacle or a human worker within its workspace, could automatically shut itself down in order to prevent any harm to itself and/or the human worker.

The advantage of Cobots is that it is small, lightweight, and easy to assemble. The Cobot can carry out its tasks in places where there is little space and is easy to move.

For example, you could mount this collaborative robot on a moving workbench and let it do its work somewhere else on a regular basis, but a robot can also stay in one place for a longer period of time.

Traditional industrial robots are built and programmed to do a single task at a distance from workers on the manufacturing or assembly floor. Common types include articulated arms, wheeled mobile robots, and gantry/rectilinear models, and they are often used to process large batches of single items: welding, drilling, spray application (paint, adhesive), transporting items across an area, loading, and unloading heavy items. They are large, heavy, fast, and very strong, all of which make them hazardous to humans and require them to be surrounded by fencing or other barriers. Because they operate independently of the people around them, traditional industrial robots work in parallel, not in collaboration.

Collaboration is defined less by the task performed than by the features of the robot that make it safe and helpful for working side by side with humans. Machine and person can work on the same task, assembly, object, or activity at the same time in the same physical area, such as a work cell, station, or work bench.

There are several types of collaborative robot available “off-the-shelf” which means there are options to suit a range of needs. Most cobots can also be customized and integrated into manufacturing production systems with accessories and tools like vision cameras, suction cup grippers, and welding tips (check out this example from Universal Robots on the right). Gone are the days when the only option for a robotic arm was to build a large, dedicated machine from scratch.

In stark contrast to older-style robots, bolted to the floor in a cage, collaborative models can be mobile multi-takers. They’re small and lightweight, able to be moved around the manufacturing floor or facility.

Once in their new destination, easy and intuitive GUIs allow operators to quickly switch between tasks. Many models can also be programmed for new operations by hand guiding the arm through steps at the point of need. This flexibility is helpful for small and medium-size manufacturers, especially those in high-mix/low-volume and just- in-time (JIT) settings.

Another distinguishing feature cobots share is built-in controls to enhance safe operation. These include programmable settings to create “zones” of faster or slower speeds, collision avoidance, and sensors that stop the machine when a hand or other object enters an unanticipated area. Along with safety, ergonomics can be improved with a Cobot assistant. This is especially relevant as workers age, lose dexterity, and feel effects of standing, lifting, or twisting earlier in a shift. It also offers options to broaden the range of abilities and skills needed to perform a job, such as programming the robotic arm to do a task, making adjustments to settings based on computer data, or performing a job while seated. With these capabilities you can grow your manufacturing workforce.

Rather than removing human workers from jobs entirely, cobots usually integrate into the portions of a process that are repetitive or dull enough to risk errors or injury. Their small size and dexterous movement mean they make great assistants for tasks with small parts or intricate placement – the types of jobs humans do at workbenches and on the manufacturing floor. Examples include:

- Pick and place
- Machine tending
- Packaging and palletizing
- Process tasks, when equipped with end effector tools (e.g. gluing, drilling, welding)
- Finishing (sand, polish, deburr, trim)
- Quality inspection, when equipped with a vision camera.
- Assembly
- Dispensing (e.g. adhesive, lubricant, sealant)
- Painting, coating, dipping

The scope of construction automation is extensive, spanning all stages of the construction life cycle, from original planning and design to facility construction, operation and maintenance, and final disassembly and recycling of buildings and engineering structures. Recent advancements in the domains of computer science and robotics have aided in the creation of new construction technologies. Japan, a world leader in robotics and automation, has produced a slew of innovative technologies and tools that have aided the construction sector in reducing human labor, lowering construction costs, and shortening project timelines while increasing productivity.

Construction work is sometimes carried out in hazardous conditions, necessitating the use of robotics to optimize equipment functioning and increase worker safety and quality. Because of the automated construction process, there is no downtime throughout the year. More and 2/5 more machines and equipment should be used in the building sector for rapid construction with reduced danger and good quality. The use of machines, robots, and other automated devices at appropriate locations reduces human effort and risk. Because India possesses the world's second-largest manpower, automation is not a replacement for human labor, but rather a necessary supplement to meet the demands of megaprojects and fast-track building. Because unskilled labors do not do good quality work in comparison to

automation, human power is being replaced by emerging technologies of automation in India today. When compared to unskilled people, automation boosts construction project productivity, reduces the duration and tedious work, improves construction safety, and improves the quality of work. The main research activities in the construction sector are grouped into two large areas based on applications: civil infrastructure and housing building. Road, tunnel, and bridge construction, as well as earthwork, are examples of typical civil infrastructure robot applications. Building skeleton erection and assembly, concrete compaction, interior finishing, and other applications fall under the category of house construction.

## II. LITERATURE SURVEY

Automation using industrial robots has been a driver in enterprises during the last decades, leading to an ever-increasing number of industrial robots being implemented in factories [1]. However, the research agenda in the past view years has focused on developing smaller lightweight robots which enable direct interaction with humans without the need for a physical separation, Research that focuses on practically relevant factors to guide HRI (Human Robot Interaction) research, inform cobot development, and support companies in overcoming apparent barriers.

A collaborative robot is something of growing interest for companies in the manufacturing industries to implement. However, a collaborative robot is quite new in today's market. An issue that arises is that no implementation process for collaborative robots exists today, as well as no requirement guide for skills, as well as actors, has been defined [2]. To examine how an implementation process of collaborative robots in manufacturing companies could look like. Focusing on charting the integration process steps of a collaborative robot, and identifying the actors as well as skills needed for successful Cobot integration, with the aim achieve the goal.

New research inquiries in human-robot collaboration. We have built up a framework prepared to do independent following and performing table-best protest object manipulation with humans and we have actualized two different activity models to trigger robot activities. The idea here is to explore collaborative systems and to build up a plan for them to work in a collaborative environment which has many benefits to a single more complex system [3].

In the paper, two robots that cooperate among themselves are constructed. The participation linking the two robotic arms, the torque required and parameters are analysed. Thus, the purpose of this paper is to demonstrate a modular robot system which can serve as a base on aspects of robotics in collaborative robots using haptic [4].

In this paper, an overview of collaborative industrial scenarios and programming requirements for cobots to implement effective collaboration is given. Then, detailed reviews on cobot programming, which are categorised into communication, optimisation, and learning, are conducted. Additionally, a significant gap between cobot programming implemented in industry and in research is identified, and research that works towards bridging this gap is pinpointed. Finally, the future directions of cobots for industrial collaborative scenarios are outlined, including potential points of extension and improvement [5].

This paper reports on a new method for the efficient safety design of an interactive manufacturing system is studied and its effectiveness is verified. First, applications of the interactive manufacturing systems were analysed and a new concept of consecutive application was created. Then, by applying this concept, a method was devised to select the most appropriate safety criteria as a basis for safety design. Furthermore, a method for systematic hazard identification and determination of the need for risk reduction was studied and its effectiveness was confirmed [6]. Research of these methods, designers can demonstrate safety of the interactive manufacturing system that adequate cost and user-friendly system.

We present results on the development of a collaborative human-robot manufacturing cell for homo-kinetic joint assembly. The robot alternates active and passive behaviours during assembly, to lighten the burden on the operator in the first case, and to comply with his/her needs in the latter. Our approach can successfully manage direct physical contact between robot and human, and between robot and environment. We present results on the development of a collaborative human-robot manufacturing cell for homo-kinetic joint assembly [7]. The robot alternates active and passive behaviours during assembly, to lighten the burden on the operator in the first case, and to comply with his/her needs in the latter.

This paper introduces functionalities and the system architecture of the highly versatile Cobot Studio research environment, presents an initial application, and discusses methodological benefits of using immersive VR games for research into human-robot collaboration [8].

Our thematic analysis revealed that, contrary to the envisioned use, experts described most Cobot applications as only low-level interactions with little flexible deployment, and experts felt traditional robotics skills were needed for collaborative and flexible interaction with cobots. We conclude with design recommendations for improved future robots, including programming and interface designs, and educational technologies to support collaborative use [9]. Author proposes a set of design guidelines for cobots based on existing literature on heuristics and cobot UI design. The guidelines were further developed on the basis of modified heuristic evaluations by researchers with robotics expertise, as well as interviews with cobot Experience design experts. The resulting design guidelines are intended for identification of usability problems during heuristic evaluation of the UI (User Interfacing) design of cobot systems.

This paper is concerned with the design of robots and associated UIs that are part of collaborative industrial robot systems cobots. Cobots are systems that are intended for collaborative operation, i.e. the concurrent execution of tasks by human and robot in the collaborative workspace [10].

The paper starts with an introduction of human-robot collaboration, presenting the related standards and modes of operation. An extensive literature review of works published in this area is undertaken, with particular attention to the main industrial cases of application. The paper concludes with an analysis of the future trends in human-robot collaboration as determined by the authors [11].

The aim of this article is to examine current approaches to Cobot safety by showing that these approaches can additionally benefit from systems thinking methods.

This explorative research dimension is expected to overcome an overly narrow interpretation of safety issues, anticipating the challenges ahead in ever more complex Cobot applications. The safe operation of Cobot applications can only be achieved through alignment of design, training, and operation of such applications [12].

These methods each provide interesting extensions to complement the traditional understanding of risk as required by current and future industrial Cobot implementations [13]. The power of systemic methods for safer and more efficient cobot operations lies in revealing the distributed and emergent result from joint actions and overcoming the reductionist view from individual failures or single agent responsibilities.

We propose a human entered approach to improve the introduction of collaborative robots in the industry. Several industrial applications are studied within Safran and Airbus Safran Launchers. In this paper, we present the first application of our work on a pyrotechnic tank cleaning workstation [14]. Our approach is illustrated with the design of a solution through several simulation steps involving the workstation's operators. In particular, the current design of a prototype based on a teleoperated robot is introduced.

### III. PROPOSED METHODOLOGY

In the dissertation following methodology has been decided to measure and manage the

- By operating advance technology (Application Of COBOT) at construction project reduce delay in transporting of material and increase efficiency of work that reflect of time and cost in construction Sector.
- From literature found that because of frequent change of project managers, Appointment of staffs in the site who are not experienced, and Non sequential progress of works and that Work was not followed as per procedure instead it was followed as per availability of resources caused delays in construction project on pandemic situation.
- Unavailability of adequately trained health workers and lack of experience in managing an unprecedented emergency; the pandemic and the confinement measures created a psychosocial burden for the population and, especially, the wellbeing of the health workforce.
- The construction industry is the vehicle through which physical development is achieved, and this is truly the locomotive of the national economy. The more resources, engineering know-how, labor, materials, equipment, capital, and market exchange provided from within the national economy, the higher the extent of self-

reliance. The increasing complexity of infrastructure projects and the environment, within which they are constructed, place greater demands on construction managers to deliver projects on time, within the planned budget and with high quality.

- Therefore, improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost savings for the country as a whole. Efforts directed to cost and time effectiveness were associated with managing time and cost.
- It also aims to identify the main factors that lead to project delays and to suggest recommendations on how to overcome or mitigate effects of the problem. Data is gathered from responses from questionnaire survey and interviews with those involved in automation construction project.
- The surveys and research findings indicate that delay incidents & Accidents occur mainly during the construction phase of a project and one or more parties usually contribute to delay. This paper highlights the importance of having more experienced and capable construction managers as well as skilled laborers to enable the industry to develop at a faster rate either nationally or internationally.
- A questionnaire and personal interviews have formed the basis of this research. Factor analysis and regression modelling were used to examine the significance of the delay factors. From the factor analysis, most critical factors of construction delay were identified.

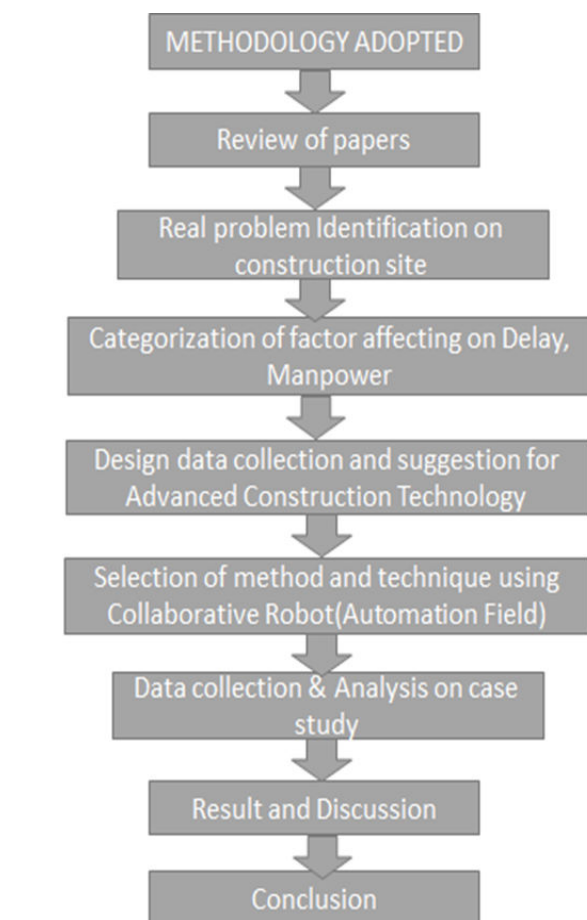


Fig.3.1. Proposed system block diagram

IV. RESULTS

R II METHOD

The sample for this study is relatively small. As a result, the analysis had combined all groups of respondents (clients, consultants, contractors and regulatory boards) in order to obtain significant results. Data was analyzed by calculating frequencies and Relative Importance Index (RII). In this project, Relative Importance Index technique approach is used for data analysis. This technique is used to determine the relative importance of the various factors affecting the waste generation working on construction sites. The data analysis was carried out using SPSS software. SPSS was used to generate the frequency (fi) of the response category index for the cause-and-effect factors. The relative importance index (RII) for each factor was calculated using the frequency data for each response categories generated from SPSS.

Assessment of questionnaire was carried out using three-point likert scale from 1 to 5 representing can be not at all, no, most of the times, yes respectively. Data analysis was done calculating Relative Important Index (RII) by following formula. Ranking of the various factors according to their significance, and calculating their Relative Importance Index  $R II = \Sigma W / A * N$

Where, W = weight given to each factor by respondents

$$\Sigma W = 5 \times W5 + 4 \times W4 + 3 \times W3 + 2 \times W2 + 1 \times W1$$

A = highest weight (i.e. 5)

N = total number of respondents (N=150)

These rankings made it possible to cross-compare the relative importance of the factors. Each individual causes RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the factors of material management in Indian construction industry.

Table no.1

Project name:		*To boost Build Productivity and Speed by Utilizing Automation Industry			
Number of responses	50				
Name of Method	R II method				
	$\Sigma W = 3 \times N3 + 2 \times N2 + 1 \times N1$				
Sr. No.	Questions	YES(N1)	No(N2)	CANT SAY(N3)	Total
1	1. Do you believe that poor management system contributed to the Construction industry late completion?	44	2	4	50
2	2. Is it true that heavy rain causes building activity to slow down?	44	4	2	50
3	3. Do you believe that using advanced construction techniques like Cobot to build a High rise structure is the best option?	45	3	2	50
4	4. Do you believe that this project's delays are due to Funding and payment issues?	33	7	10	50
5	5. Do you think that project will be delayed as a result of the late release of the site, drawings, and materials?	39	8	3	50
6	6. Is the project team heavily reliant on one another for assistance, intelligence, or enforcement to complete their tasks, causing a delay in the completion of the High rise structure?	33	11	6	50
7	7. Do you believe the errors in layout caused by incorrect data in drawings lead to further work being done?	44	2	4	50
8	8. Do you believe the project team members and staff lack expertise in the construction of an emergency on Site without any Technology?	37	8	5	50
9	9. Can you feel there is a lot of uncertainty on the project for the project team members?	31	13	6	50
10	10. Do you believe that if advanced building techniques were used, any of the above factors will be eliminated?	43	3	4	50
11	11. Do you believe that India's Construction is sufficient to solve the Pandemic problem using Cobot?	9	36	5	50
12	12. Do you think that quality of the work would suffer as a result of the fast-track construction using Cobotic Technology?	39	8	3	50
13	13. Do you think the best choice for constructing a High rise building is to use advanced building techniques?	46	2	2	50
14	14. Do you believe that the task of construction management is required to complete the project on time?	46	2	2	50
15	15. Do you believe that a High rise Building should be built at the start of the Pandemic Situation on Site?	43	1	6	50

Table no.2

Sr. No.	Questions	YES(1)	No(2)	Other(3)	Total	Total Number(N)	A x N	RII	Ranks
1	Q1	44	4	12	60	50	150	0.4	9
2	Q2	44	8	6	58	50	150	0.39	10
3	Q3	45	6	6	57	50	150	0.38	11
4	Q4	33	14	30	77	50	150	0.51	2
5	Q5	39	16	9	64	50	150	0.43	6
6	Q6	33	22	18	73	50	150	0.49	4
7	Q7	44	4	12	60	50	150	0.4	9
8	Q8	37	16	15	68	50	150	0.45	5
9	Q9	31	26	18	75	50	150	0.5	3
10	Q10	43	6	12	61	50	150	0.41	8
11	Q11	9	72	15	96	50	150	0.64	1
12	Q12	39	16	9	64	50	150	0.43	6
13	Q13	46	4	6	56	50	150	0.37	12
14	Q14	46	4	6	56	50	150	0.37	12
15	Q15	43	2	18	63	50	150	0.42	7

2. Are you aware about robotic technology in construction ?

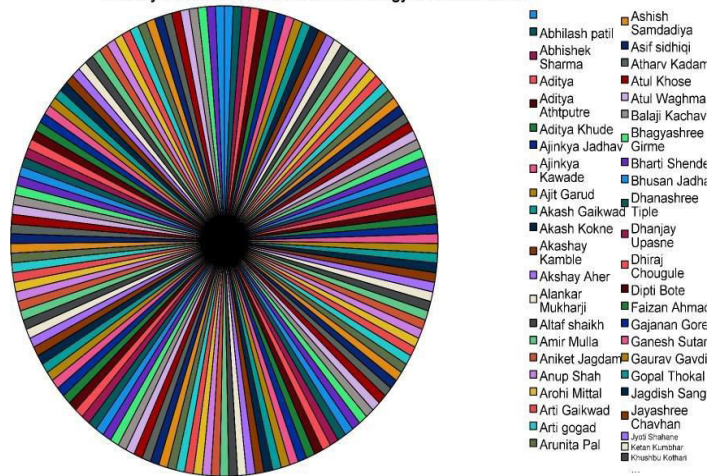


Fig.4.1. Pie Chart based on variables.

V. CONCLUSION

- The major goal of this study is to discover how automation is now used in construction and on-site construction labor. And the most significant impediments to the use of automation technologies in the building industry.
- Factors relating to the barriers are discovered through literature reviews and case studies. After that, questionnaires are created for survey work, and the data is evaluated using the frequency analysis approach.
- The high cost, size of the firm, and technology that is difficult to maintain and update are top rated barriers in the deployment of automation in construction, according to the Frequency analysis technique.
- Barriers such as workers' lack of technological understanding and technology that is difficult to use are among the lowest scored in the survey. The cost of automation technology (buy cost, maintenance cost, and upgrade costs), the size of the firm, project magnitude, and staff limit were all found to have a strong link with the amount of site automation. From this study, it can be concluded that barriers will be reduced by developing technologies that are

easier to use and understand, as well as training programmers for workers and employees, which are rated highest in the survey, and making technology more affordable to maintain and update, which is rated lowest in the survey.

- The use of automation technology in construction had a significant impact on project performance, with a stronger impact on enhanced job quality, time savings, improved working conditions, increased safety, and increased productivity. Because of the high complexity, nature of the development process, and technological advancements in development, a long-term plan is required to provide access to cutting-edge development methodologies.
- In this adjustment technique, modelers, specialists, and every other member of the development process must be coordinated. Automation will be improved in both the short and long term and will be tailored to the specific application.
- The necessity for current infrastructure project and development enterprises to boost productivity, worker safety, and job quality is one of the advantages of implementing automation technologies.
- Small and medium-sized businesses require automation advancements in a variety of areas.

### REFERENCES

1. Application of Automation and Robotics Technology in High-Rise Building Construction: An Overview 35th International Symposium on Automation and Robotics in Construction (ISARC 2018).
2. A proposed “model for adoption” of high technology products (robots) for Indian construction industry S. Jain and Dr. M. Phadtare National Institute of Construction Management and Research, Balewadi, Pune, India
3. Cao, D., Li, H., Wang, G., & Huang, T. (2017). Identifying and contextualizing the motivations for BIM implementation in construction projects: An empirical study in China. *International journal of project management*, 35(4), 658-669.
4. Bogue R. What are the prospects for robots in the construction industry? *Ind Robot* 2018; 45:1–6.
5. Kaneko K, Kaminaga H, Sakaguchi T, et al. Humanoid robot HRP-5P: an electrically actuated humanoid robot with high-power and wide-range joints. *IEEE Robot Autom Lett* 2019; 4:1431–8
6. Ma G, Wang L, Ju Y. State-of-the-art of 3D printing technology of cementitious material: an emerging technique for construction. *Sci China Technol SC* 2018; 61:475–95
7. Satasivam S, Bai Y. Mechanical performance of modular FRP-steel composite beams for building construction. *Mater Struct* 2016; 49:4113–29.
8. Eversmann P, Gramazio F, Kohler M. Robotic prefabrication of timber structures: towards automated large-scale spatial assembly. *Construction Robotics* 2017; 1:49–60
9. Hunt CJ, Wisnom MR, Woods BK. Design, manufacturing, and testing of an automated winding machine for WrapToR composite truss structures. In: 18th European Conference on Composite Materials, Athens, Greece, 2018; 1–8.
10. Peshkin, M. A., Colgate, J. E., Wannasuphprasit, W., Moore, C. A., Gillespie, B. and Akella, P., *Cobot Architecture*, *IEEE Trans. Robot. Automat.*, vol. 17, pp. 377– 390, Aug. 2018 (13) <http://lms.mech.northwestern.edu/projects/utla/>
11. Wannasuphprasit, W., Akella, P., Peshkin, M.A., Colgate, J.E. “Cobots: a novel material handling technology,” *ASME Vol. 98-WA/MH-2*, 2019



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  [ijirset@gmail.com](mailto:ijirset@gmail.com)



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details