ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Special Issues– II Jan – Feb, 2025

OPEN ACCESS Original Research Article

A STUDY ON THE AWARENESS AND ADOPTION OF IOT (INTERNET OF THINGS) DEVICES AMONG INDIAN HOUSEHOLDS

** Ms. Anushka Dhole, ** Ms. Chinmayi Yeram,*** Ms. Payal Singh Parihar & **** Dr. Abhijeet Rawal*

**Research Students*

Abstract:

This research paper "A Study on the Awareness and Adoption of IoT (Internet of Things) Devices Among Indian Households" and deals with the perception and adoption of IoT devices among Indian households in relation to convenience, security, and efficiency. Affordability, accessibility, and usage patterns have been highlighted in this regard. This is growingly becoming adopted for smart homes because of Digital India and Smart Cities. Using a descriptive research approach and data collected from Mumbai, Kalyan, Dombivli, and Pune. This study identifies challenges such as regional disparities, security concerns, and high initial costs. The findings aim to guide policymakers and industry stakeholders in enhancing IoT adoption while addressing barriers like digital literacy and infrastructure gaps.

Keywords: *Internet of Things (IOT), Security, Awareness, Adoption, Accessibility, Affordability*

Introduction

Technology is changing the world, and in India, the demand for IoT is booming, with the initiatives of Digital India and Smart Cities. The number of IoT connections in India is expected to reach around 500 million by 2025, with huge adoption in healthcare, agriculture, and manufacturing. IoT is revolutionizing daily life as it connects devices to share and process data into valuable insights, which enables automation and efficiency.

It enhances home living to integrate with various devices, such as lights, security cameras, thermostats, and smart TVs, which can be controlled from afar using a single tool like a phone, PC, or tablet. They improve the convenience and security of such systems while optimizing energy use, thereby saving on electricity bills for homeowners. The population and the growing number of people demanding secure, cost-effective lifestyles lead to a boom in smart home systems, thereby raising the standard of living and paving the way for smarter, more connected households.

IoT transforms many industries by gathering and sharing data with the help of embedded sensors for creating automated and efficient systems. With this technology, the digital and physical intertwine, promoting sustainability, innovation, and unprecedented insights. Despite the promising growth, several challenges prevail including data privacy concern, lack of standardization, and in house a professional workforce. However, rapid changes due to affordability and easy accessibility of IoT devices are knocking at barriers toward adoption in Indian households. This study explores the ways IoT enhances security, efficiency, and convenience, identifying the most commonly used devices and factors influencing adoption, such as pricing and accessibility. Through its integration into homes and daily lives, IoT is creating a smarter, more efficient future for India.

ISSN–2278-5655

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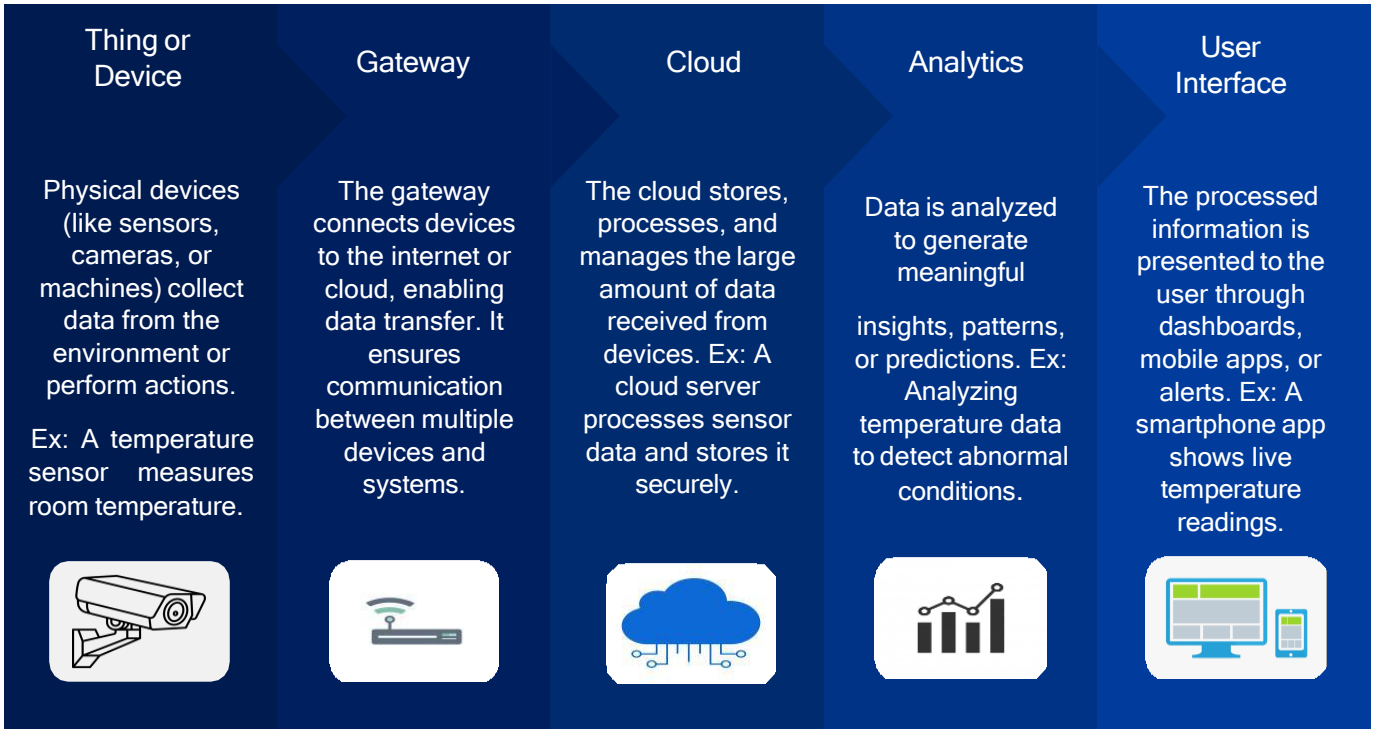

Diagram 1.1

0bjectives:

1. To measure awareness of IoT's impact on convenience, efficiency, and security in Indian households.
2. To analyze the role of affordability and accessibility in influencing IoT adoption among Indian households.
3. To identify the most preferred types of IoT devices and their usage patterns in Indian households.

Hypothesis:

1. To measure awareness of IoT's impact on convenience, efficiency, and security in Indian households.

   Null Hypothesis (H_0): Indian households have no significant awareness of IoT's impact on convenience, efficiency, and security.

   Alternative Hypothesis (H_1): Indian households have significant awareness of IoT's impact on convenience, efficiency, and security.
2. To analyze the role of affordability and accessibility in influencing IoT adoption among Indian households.

   Null Hypothesis (H_0): Affordability and accessibility do not significantly influence IoT adoption among Indian households.

   Alternative Hypothesis (H_1): Affordability and accessibility significantly influence IoT adoption among Indian households.
3. To identify the most preferred types of IoT devices and their usage patterns in Indian households.

   Null Hypothesis (H_0): There is no significant preference for specific types of IoT devices or usage patterns among Indian households.

   Alternative Hypothesis (H_1): There is a significant preference for specific types of IoT devices and usage patterns among Indian households.

ISSN–2278-5655

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OPEN ACCESS Original Research Article

Methodology:

Conceptual Framework

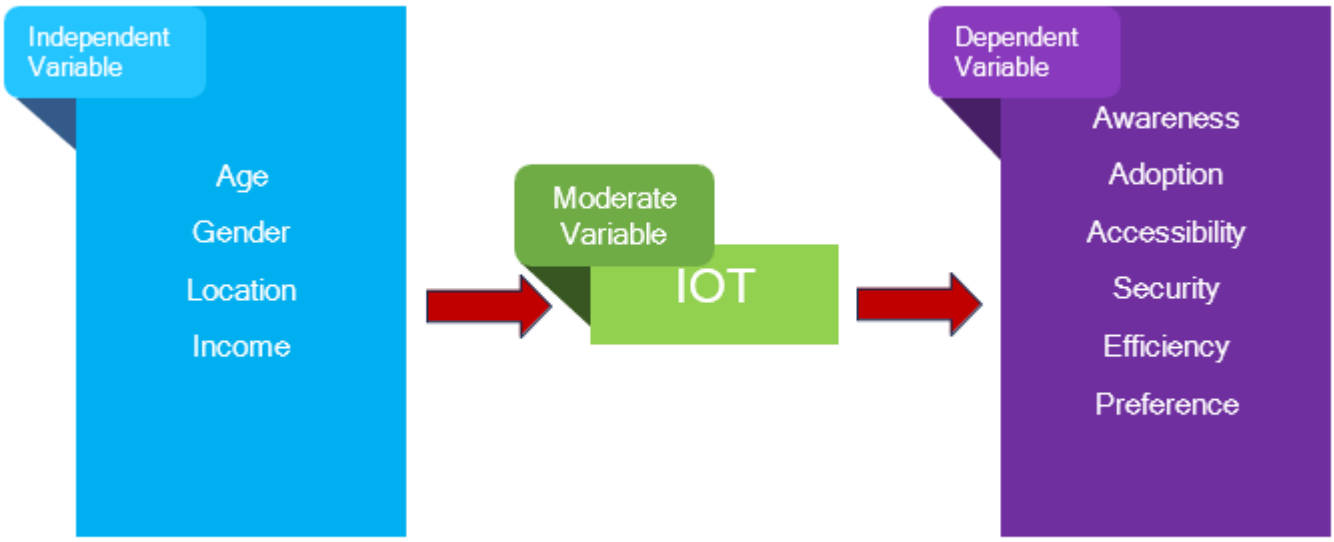

Diagram 1.2

Significance:

The study on "Awareness and Adoption of IoT Devices Among Indian Households" is important because it examines the main elements influencing how IoT technology is perceived and used. The study will assist in identifying obstacles and possibilities for boosting IoT penetration in homes by evaluating awareness levels and adoption. It also draws attention to security issues that are crucial in determining adoption decisions, such as data privacy and trust. Policymakers can utilize the findings to develop regulations that encourage firms to enhance their outreach efforts, improve product design, and strengthen security measures. Furthermore, the study contributes to academic research by offering insights into technology adoption trends in Indian households, supporting efforts to bridge the digital divide and promote inclusive technological growth.

Scope of study:

IoT (Internet of Things) holds great significance in smart cities in India and helps in the optimization of urban infrastructure. Further Research can done on traffic systems, smart grids for energy conservation, intelligent waste collection, and ecological monitoring on a real-time basis. Improvement in the standard of urban living in some of the projects initiated by the Smart Cities Mission. Also the introduction of remote health monitoring devices, wearable health trackers. In addition, studying how the government's projects such as Digital India and Viksit Bharat 2047 are continuously nurturing the IoT ecosystem by integrating digital tools into the infrastructure and promoting entrepreneurship. Affordable devices and a widespread penetration of smartphones along with a firm strategy for clean energy.

Limitations

1. Not Generalizable to Other Regions and Cultures: The results are about Indian households, and the same cannot be generalized in other regions and cultures.
2. Homogeneity of Participants: The survey mainly targeted particular demographics, where diversity in terms of income, education, and technological

ISSN–2278-5655

AMIERJ Aarhat Multidisciplinary International Education Research Journal

Volume–XIV, Special Issues– II Jan – Feb, 2025

OPEN ACCESS Original Research Article

exposure has been ignored.

3. Self-Reported Data: It is based on self-reported data, which is prone to errors and biases.
4. Dynamic Technology Landscape: The pace at which the IoT technology evolves may make the findings outdated sometime in the future.

Review of literature:

SR.NO	Authors	Years	Research	Gap
1	Rakesh Roshan, Abhay Kr. Ray	November 2016	Growing IoT adoption in smart homes, focusing on benefits, challenges, and advancements. Most studies are from developed countries.	Lack of research addressing implementation challenges specific to India, such as inconsistent internet connectivity, high device costs, and maintenance issues.
2	Bayo Olushola Omoyiola	December 2019	Studies on IoT adoption highlight factors like technological readiness, organizational support, and global challenges like security.	Lack of focused analysis of IoT adoption challenges in specific contexts, such as organizations in developing countries.
3	Shreya Gupta, Madhvendra Misra, Jitendra Yadav	January 2021	Smart homes enable remote control of appliances, offering convenience, energy savings, and security. Cybersecurity risks are a challenge.	Studies focus on technology and market growth but overlook user priorities, adoption barriers, and security concerns, warranting further exploration
4	Rakesh Kumar Giri	August 2022	IoT connects devices in industries like home automation, healthcare, and agriculture. Security and privacy concerns are critical challenges.	Limited focus on India-specific challenges such as the impact on infrastructure, regulatory frameworks, and security risks.
5	Amira REMADNA	January 2023	IoT influences consumer behaviour across disciplines like psychology, technology, and management, shaping consumer intentions and decisions.	Lack of comprehensive research focusing on the marketing perspective, particularly the impact of IoT on consumer intentions and behaviour.

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6	Abdulrahman S.F.A Alenizi, Khamis A. Al-Karawi	January 2023	IoT integrates devices, sensors, networks, and applications for communication and data sharing. Challenges include device integration.	Existing research addresses IoT's potential and challenges but lacks detailed analysis of region-specific barriers and their resolutions.
7	Sanjay S Tippannavar, Yashwanth S. D.	December 2023	IoT is transformative across sectors like healthcare, agriculture, and industrial automation. India's IoT adoption has immense potential.	Limited focus on India-specific challenges such as infrastructure readiness, cost- effectiveness, and sectoral adoption.

Research methodology:

In this study, the Descriptive Research approach, also known as Quantitative approach has been conducted to analyze IoT awareness and adoption by Indian households. The primary source of data is retrieved from 100 respondents in Thane, Mumbai, Dombivli and Pune by applying the convenience sampling technique for accessibility with the help of structured questionnaires. Secondary data is sourced from scholarly articles, journals, and existing research papers.

Data Analysis & Discussion: Data analysis involves compiling, organizing, and processing raw data to identify patterns, trends, and insights, often using tools like SPSS and Excel. It transforms large datasets into meaningful results, while data interpretation contextualizes these findings, providing practical insights aligned with specific goals or situations.

Case Processing Summary:

		N	%
Cases	Valid	62	100.0
	Excluded[a]	0	.0
	Total	62	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.728	.720	18

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Item Statistics

	Mean	Std. Deviation	N
PA	1.806	.9554	62
PG	1.565	.4999	62
V01	1.548	.5017	62
PQ	2.581	.8787	62
V02	3.145	.9892	62
V03	2.274	.9779	62
V04	2.919	1.0130	62
V05	1.403	.4945	62
V06	2.742	.8672	62
V07	3.194	.9024	62
V08	2.968	1.0238	62
V09	1.516	.5038	62
V10	3.081	.9286	62
V11	1.339	.4771	62
V12	2.565	.9687	62
V13	1.339	.4771	62
V14	2.903	.9532	62
V15	2.790	.7921	62

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
41.677	38.583	6.2115	18

Table 1.1

The current study had conducted reliability test using Cronbach's alpha method using spss software which show .728 on the scale which indicate reliable.

ANOVA ANALYSIS:

ANOVA, or Analysis of Variance, is a statistical method used in research to determine whether there are significant differences among the means of three or more groups. It evaluates the variation between groups in comparison to the variation within groups to assess the influence of one or more independent variables. A significant result suggests that at least one group's mean differs from the others. ANOVA is widely applied in experimental studies to examine the effects of treatments or interventions.

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Hypothesis 1

"Measuring familiar are you with IoT (Internet of Things)"

SUMMARY:

Groups	*Count*	*Sum*	*Average*	*Variance*
V01 (A)	100	320	3.2	1.60
V01 (B)	100	321	3.21	1.52
V01 (C)	100	338	3.38	1.47
V01 (D)	100	379	3.79	1.40
V01 (D)	100	370	3.7	1.51
PA	100	127	1.27	0.34
PG	100	163	1.63	0.24

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	611.63	6.00	101.94	88.44	3.16554E-82	2.11
Within Groups	798.76	693.00	1.15			
Total	1410.39	699.00				

Table 1.2

The extremely low p-value (3.16554E-82), which is far below the 0.05 significance threshold, demonstrates a significant difference among the groups analyzed in the ANOVA test. Additionally, the F-statistic (88.44) exceeds the critical F-value (2.11), providing further evidence against the null hypothesis (Ho). This analysis rejects the null hypothesis and supports the alternative hypothesis, indicating a significant awareness of IOT.

"In what ways do you think IoT devices improve household efficiency?"

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V03 (A)	100	360	3.6	1.86
V03 (B)	100	354	3.54	1.71
V03 (C)	100	388	3.88	1.82
V03 (D)	100	389	3.89	1.90
V03 (E)	100	282	2.82	1.66
PL	100	159	1.59	0.91

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	394.82	5	78.96	48.05	9.36E-42	2.23
Within Groups	976.14	594	1.64			
Total	1370.96	599				

Table 1.3

ISSN–2278-5655

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The ANOVA results indicate a highly significant difference among the groups analysed, as evidenced by the extremely low p-value (9.36E-42), which is well below the 0.05 significance threshold. Furthermore, the F-statistic (48.05) surpasses the critical F-value (2.23), confirming strong evidence against the null hypothesis (H_0). These findings suggest that IoT devices significantly improve household efficiency.

"Impacted by IoT (Internet of Things) devices in different area of life."

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V04 (A)	100	286	2.86	1.41
V04 (B)	100	301	3.01	1.50
V04 (C)	100	334	3.34	1.56
V04 (D)	100	333	3.33	1.54
V04 (E)	100	356	3.56	1.76
V04 (F)	100	321	3.21	1.42
V04 (G)	100	339	3.39	1.76
V04 (H)	100	331	3.31	1.69
PA	100	127	1.27	0.34

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	383.43	8	47.93	33.21	5.88984E-46	1.95
Within Groups	1285.70	891	1.44			
Total	1669.13	899				

Table 1.4

The ANOVA results indicate a highly significant difference among the groups regarding the impact of IoT devices on various areas of life. This is evidenced by the extremely low p-value (5.88984E-46), which is much smaller than the standard significance level of 0.05. Additionally, the F-statistic (33.21) is substantially higher than the critical F-value (1.95), providing strong evidence to reject the null hypothesis (H_0). These findings suggest that the impact of IoT devices significantly varies across the analyzed groups.

"Primary concern regarding the security of IoT (Internet of Things) devices."

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V05 (A)	100	288	2.88	1.702626263
V05 (B)	100	333	3.33	1.536464646
V05 (C)	100	311	3.11	1.290808081
V05 (D)	100	314	3.14	1.353939394
V05 (E)	100	335	3.35	1.785353535
PI	100	164	1.64	1.465050505

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ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	207.6683333	5	41.53366667	27.28217497	6.91428E-25	2.229193096
Within Groups	904.29	594	1.522373737			
Total	1111.958333	599				

Table 1.5

The ANOVA results show a significant difference among the groups, with a p-value of 6.91E- 25, well below the 0.05 threshold. The F-statistic (27.28) exceeds the critical F-value (2.23), providing strong evidence to reject the null hypothesis (H_0). These findings highlight that security concerns significantly influence perceptions of IoT devices.

Hypothesis 2

"Affordability of IoT devices in household"

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V06 (A)	100	277	2.77	1.73
V06 (B)	100	305	3.05	1.40
V06 (C)	100	268	2.68	1.37
V06 (D)	100	317	3.17	1.37
V06 (E)	100	314	3.14	1.92
PI	100	164	1.64	1.47

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	*165.55*	*5*	*33.11*	*21.44*	*9.52E-20*	*2.23*
Within Groups	*917.41*	*594*	*1.54*			
Total	*1082.96*	*599*				

Table 1.6

The ANOVA results demonstrate a significant difference among the groups, as indicated by a p-value of 9.52E-20, far below 0.05. The F-statistic (21.44) is greater than the critical F-value (2.23), supporting the rejection of the null hypothesis (H_0). This implies that affordability significantly affects the adoption of IoT devices in households.

"Availability of IoT (Internet of things) devices in locality."

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V07 (A)	100	381	3.81	1.53
V07 (B)	100	353	3.53	1.26
V07 (C)	100	366	3.66	1.70
V07 (D)	100	356	3.56	1.76
V07 (E)	100	366	3.66	1.64
PL	100	159	1.59	0.91

ISSN–2278-5655

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ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	356.39	5	71.28	48.55	3.88E-42	2.23
Within Groups	872.01	594	1.47			
Total	1228.40	599				

Table 1.7

The analysis highlights a significant difference among the groups, with a p-value of 3.88E-42, well below 0.05. The F-statistic (48.55) exceeds the critical F-value (2.23), rejecting the null hypothesis (H_0). These findings suggest that the availability of IoT devices significantly varies across localities.

Hypothesis 3

Current preference of IoT (Internet of Things) device in households.

Groups	*Count*	*Sum*	*Average*	*Variance*
V10 (A)	100	275	2.75	1.89
V10 (B)	100	296	2.96	1.63
V10 (C)	100	312	3.12	1.52
V10 (D)	100	349	3.49	1.63
V10 (E)	100	347	3.47	1.79

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	41.47	4	10.37	6.13	8.05E-05	2.39
Within Groups	837.05	495	1.69			
Total	878.52	499				

Table 1.8

The ANOVA results show a significant difference among the groups, with a p-value of 8.05E- 05, below the 0.05 threshold. The F-statistic (6.13) is higher than the critical F-value (2.39), leading to the rejection of the null hypothesis (H_0). This indicates that household preferences for IoT devices vary significantly.

ISSN–2278-5655

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SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
V13 (A)	100	295	2.95	1.66
V13 (B)	100	318	3.18	1.48
V13 (C)	100	306	3.06	1.71
V13 (D)	100	328	3.28	1.60
V13 (E)	100	324	3.24	1.42
PI	100	164	1.64	1.47

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	195.37	5	39.07	25.10	5.43E-23	2.23
Within Groups	924.59	594	1.56			
Total	1119.96	599				

Table 1.9

The analysis reveals a significant difference among the groups, as demonstrated by a p-value of 5.43E-23, well below 0.05. The F-statistic (25.10) exceeds the critical F-value (2.23), leading to the rejection of the null hypothesis (H_0). This indicates that primary concerns play a significant role in influencing preferences for IoT devices.

Recommendation:

1. **Affordable and Modular Smart Home Solutions**
   The possibility of using multiple IoT modules as multi-functional, which could offer minimal features like smart lighting and temperature control at initial stages, thereby reducing the high initial cost but allowing future enhancements, would benefit middle-class families. The availability of government support under Aatmanirbhar Bharat and internet-based integration will be helpful in such cheap solutions.
2. **IoT-Driven Home Energy Management**
   Smart home technologies with energy efficiency, like IoT-controlled lighting, thermostats, and energy monitors, are reducing electricity consumption. Solar panels have further increased savings. Cooperation between utility providers and IoT companies may be designed to offer incentive or discount schemes to adapt while public campaigns to raise awareness about savings can be initiated.
3. **Enhanced Home Security with IoT**
   These include security solutions like smart locks, motion sensors, and even CCTV cameras all managed from one portal, alerting in real time and enabling viewing remotely. Secure cloud storage needs to be data privacy-based with affordable subscription plans that allow a professional to control security solutions on your behalf.
4. **Importance of IoT-Enabled Air Purifiers in India**
   IoT-enabled air purifiers can address indoor air pollution through real-time monitoring and efficient filtration. To enhance adoption, region-specific, affordable models need to be made available that target pollutants such as dust and allergens. Government initiatives such as the National Clean Air Programme (NCAP) will further help make them more accessible and create more awareness about health benefits.

ISSN–2278-5655

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Volume–XIV, Special Issues– II Jan – Feb, 2025

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Summary of findings:

Indian households are keenly aware of the potential that IoT holds for increased convenience, efficiency, and security. A smart home automation and wearable device is most popular in this regard. Accessibility plays a great role in the adoption of such services since urban areas have better availability and affordability compared to rural areas. It is necessary to consider compatibility as well as ease of integration for IoT devices. Security concerns- data breaches, privacy issues-make many wary to fully adopt this technology, but one of the chief drivers is certainly convenience. And the applications will include real-time monitoring, savings in energy costs, and some level of automation. Wealthier households and those with superior infrastructure will drive the advanced uses of IoT better than others in rural areas which are not too digitally literate and have a lot fewer alternatives.

Conclusion:

This study therefore brings to light the rising trend of IoT usage among Indian household settings. Notably, in such studies, convenience, efficiency, and safety were some key drivers in such contexts. Further, findings illustrate that despite greater awareness, factors of affordability and accessibility significantly drive adoption rates for IoT devices in these areas, which, being better infrastructure-bound, adopt better and faster means of technology with regard to its benefits, especially urban settings as opposed to limited availability and literacy issues within the rural areas. These differences point the need for studying in greater details socio-economic influences in adoption tendencies.

Furthermore, the study reveals a nuanced relationship between awareness and adoption, where households with greater familiarity with IoT are more likely to invest in its benefits. Security concerns, such as data privacy and trust, remain major barriers that need to be addressed to foster wider adoption. Overall, IoT technology continues to reshape the way households operate, offering a glimpse into a future defined by smart, interconnected living.

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Cite This Article:

Ms. Dhole A., Ms. Yeram C., Ms. Parihar P.S. & Dr. Rawal A. (2025). *A Study on the Awareness and Adoption of IoT (Internet of Things) Devices Among Indian Households***. In Aarhat Multidisciplinary International Education Research Journal: Vol. XIV (Number I, pp. 187 – 198)** ***DOI:*** ***https://doi.org/10.5281/zenodo.15252791***