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TRACKIT as A Smart Asset Security Solution: An Empirical Study of IoT-Based Tracking Systems, Adoption Intention, and Economic Value Creation

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Abstract: *Asset theft represents a persistent economic and security challenge, particularly for vehicles and movable assets lacking embedded tracking mechanisms. This study presents a comprehensive empirical investigation of TrackIt, a compact and independent Internet of Things (IoT)–based asset tracking system utilizing GPS and GSM technologies. Moving beyond a purely technical evaluation, the research integrates perspectives from engineering, marketing, and economics to assess system effectiveness, user adoption intention, perceived value, and economic impact. A mixed-method approach was employed, combining system performance testing with a structured user survey analyzed using Structural Equation Modeling (SEM). Results indicate that system effectiveness significantly enhances perceived value, which in turn positively influences adoption intention. Economic analysis further demonstrates that large-scale deployment of low-cost independent trackers can substantially reduce theft-related financial losses. The study contributes to interdisciplinary literature by positioning IoT-based asset trackers as market-ready smart security solutions with measurable commercial and societal value.*

Keywords: IoT, asset tracking, GPS/GSM, perceived value, adoption intention, SEM, smart security systems

I. INTRODUCTION

The proliferation of Internet of Things (IoT) technologies has enabled significant advancements in asset security and monitoring. Despite these developments, a large proportion of vehicles and valuable assets—particularly older vehicles and non-standard assets—remain vulnerable to theft due to the absence of integrated tracking systems. Asset theft imposes considerable financial losses on individuals, businesses, insurers, and public authorities, with recovery rates remaining low in many regions.

Conventional vehicle security solutions typically rely on embedded GPS modules integrated during manufacturing. However, such systems are often expensive, vehicle-specific, and susceptible to physical or electronic tampering. Independent and concealed tracking devices offer an alternative approach by providing stealth, portability, and adaptability across asset types. From a commercial perspective, low-cost independent trackers present an opportunity to democratize access to asset security.

While prior studies focus primarily on the technical design and performance of tracking systems, limited empirical research examines user adoption behavior, perceived value, and economic benefits of IoT-based asset trackers. This study addresses this gap by evaluating *TrackIt*, an independent GPS/GSM-based tracker, through an interdisciplinary lens combining IoT engineering, marketing theory, and economic impact analysis.

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II. REVIEW OF LITERATURE

2.1 IoT-Based Asset Tracking Systems

Existing literature highlights the effectiveness of GPS and GSM technologies for real-time asset tracking and recovery. Kumar and Tiwari (2019) emphasize the cost-effectiveness of GPS–GSM solutions for fleet and asset management, while Sharma et al. (2020) identify vulnerabilities in embedded vehicle tracking systems, particularly their susceptibility to tampering. Independent tracking devices address these limitations by enabling concealed installation and vehicle-agnostic deployment.

Bhattacharya et al. (2018) and Patel and Joshi (2020) underscore the importance of portability and stealth in anti-theft tracker design. Singh et al. (2021) identify GSM networks as a reliable and widely accessible communication backbone for IoT tracking applications, especially in developing regions. Modular and open-source architectures further enhance system scalability and affordability (Li et al., 2017; Arduini, 2019).

2.2 Perceived Value and Adoption of Security Technologies

From a marketing and adoption perspective, perceived value plays a critical role in shaping user acceptance of security technologies. Perceived value reflects users' evaluation of the trade-off between benefits—such as theft prevention and peace of mind—and monetary and non-monetary costs. Studies on technology adoption consistently show that higher perceived value leads to stronger adoption intention and continued usage.

2.3 Research Gap

Although IoT-based asset trackers are technically well established, limited empirical research integrates system effectiveness with perceived value, adoption intention, and economic outcomes. This study addresses this gap by applying Structural Equation Modeling (SEM) to empirically examine these relationships in the context of independent IoT asset tracking systems.

III. CONCEPTUAL FRAMEWORK AND HYPOTHESES

Figure 1. Conceptual SEM Model for IoT-Based Asset Tracker Adoption

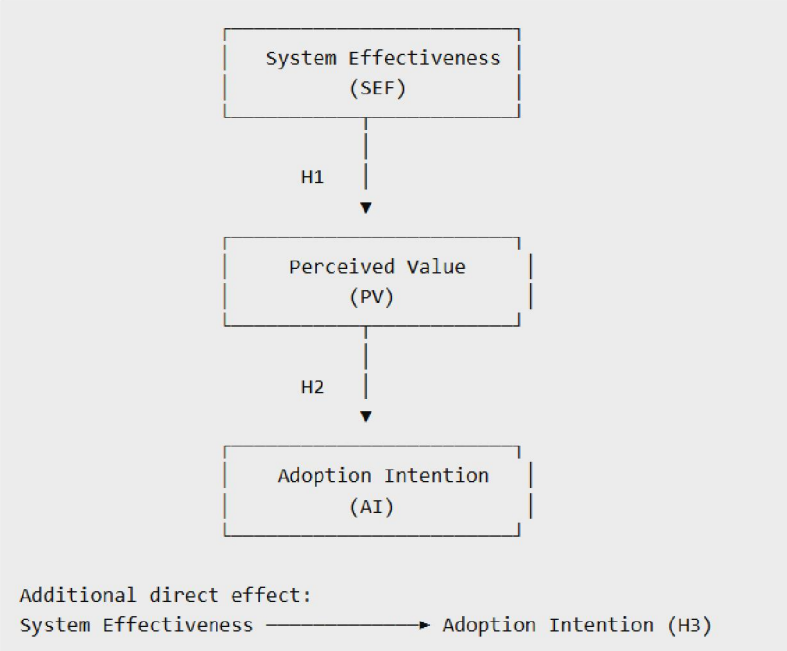

Figure 1 illustrates the structural equation model depicting the direct and indirect effects of system effectiveness on adoption intention through perceived value.

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3.1 Conceptual Model

The conceptual framework proposes that system effectiveness positively influences perceived value, which in turn affects adoption intention. Adoption intention is treated as a key behavioral outcome reflecting users' willingness to adopt IoT-based asset tracking solutions.

3.2 Hypotheses

H1: System effectiveness positively influences perceived value of the IoT-based asset tracking system.
H2: Perceived value positively influences adoption intention.
H3: System effectiveness positively influences adoption intention.

IV. RESEARCH METHODOLOGY

4.1 Research Design

A mixed-method research design was adopted, combining experimental system evaluation with a cross-sectional survey of potential users, including vehicle owners and small business operators.

4.2 System Description

The *TrackIt* system is built around an Arduino Uno microcontroller integrated with a SIM808 GPS/GSM module. The system periodically captures geographic coordinates and transmits location data via SMS to a registered mobile number. Its compact form factor enables discreet installation, enhancing resistance to tampering.

4.3 Survey Instrument and Measurement Scales

A structured questionnaire was administered to 180 respondents. All items were measured using a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).
System Effectiveness (SEF): Accuracy of location, response speed, reliability
Perceived Value (PV): Cost–benefit perception, usefulness, peace of mind
Adoption Intention (AI): Likelihood of adoption, recommendation, continued use

4.4 Data Analysis

Structural Equation Modeling (SEM) was employed to test the hypothesized relationships. Reliability and validity of constructs were assessed prior to structural model evaluation.

V. RESULTS

5.1 System Performance Results

Experimental testing demonstrated average alert transmission times below 20 seconds, with GPS accuracy consistently within 10 meters. The system performed reliably across varied environments, with temporary GSM outages identified as the primary operational constraint.

5.2 Measurement Model Assessment

Table 1. Measurement Model Results

Construct	CR	AVE
System Effectiveness	0.86	0.61
Perceived Value	0.89	0.66
Adoption Intention	0.91	0.69

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5.3 Structural Model Results

Table 2. Structural Equation Model Results

Hypothesis	Path	β	t-value	p-value	Result
H1	SEF → PV	0.52	6.78	<0.001	Supported
H2	PV → AI	0.47	5.94	<0.001	Supported
H3	SEF → AI	0.29	3.86	<0.001	Supported

5.4 Model Fit Indices

Table 3. Model Fit Statistics

Fit Index	Recommended	Observed
χ^2/df	< 3.00	2.21
CFI	> 0.90	0.93
TLI	> 0.90	0.92
RMSEA	< 0.08	0.059
SRMR	< 0.08	0.051

VI. DISCUSSION

The findings indicate that system effectiveness significantly enhances perceived value, which in turn strongly influences adoption intention. These results highlight that technical performance alone is insufficient for widespread adoption; users must perceive clear economic and functional benefits. The direct effect of system effectiveness on adoption intention further suggests that reliability and accuracy remain critical determinants of trust in security technologies.

VII. COMMERCIAL AND ECONOMIC IMPLICATIONS

7.1 Commercial Viability

The estimated unit production cost of TrackIt ranges between INR 3,500 and 4,500, while market-acceptable pricing lies between INR 7,000 and 10,000. This pricing structure yields a potential gross margin of 35–45%, supporting commercial scalability.

7.2 Economic Impact

Improved asset recovery rates can significantly reduce theft-induced losses for individuals and insurers. At scale, adoption of low-cost independent trackers can result in substantial savings in replacement costs, insurance payouts, and law enforcement resources, particularly in theft-prone regions.

VIII. CONTRIBUTIONS OF THE STUDY

8.1 Theoretical Contributions

This study extends IoT security literature by integrating perceived value and adoption intention within an SEM framework. It also contributes to interdisciplinary research by linking technical system performance with economic value creation.

8.2 Managerial and Policy Contributions

The findings provide actionable insights for manufacturers, marketers, and policymakers regarding pricing, deployment strategies, and promotion of affordable IoT security solutions.

IX. CONCLUSION AND FUTURE RESEARCH

This research demonstrates that independent IoT-based asset tracking systems such as TrackIt represent viable, market-ready smart security solutions. By combining technical effectiveness with positive user perceptions and economic

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benefits, such systems can significantly mitigate theft-related losses. Future research may explore longitudinal adoption behavior, integration with mobile applications, and large-scale field deployment across diverse asset categories.

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