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ASSESSING PUBLIC AWARENESS AND ADOPTION OF IoT INTEGRATED MINI GREENHOUSE GARDENS FOR URBAN FARMING USING THE AIDA MODEL

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Abstract:

This research investigates how the Internet of Things (IoT) can help address sustainability challenges and food security in urban cities. As urban populations grow rapidly, this research uses the AIDA model namely Attention, Interest, Desire and Action, to assess public awareness and adoption of IoT integrated mini greenhouse gardens for urban farming. Both social and technical aspects of willingness to explore resource saving methods and self suffency at home have been examined. The survey that adapted the AIDA model was conducted

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among participants aged 18 and above in urban Malaysian cities. There are 20 items in a survey with 5 items per factor of the AIDA model. This method is recognized for reliably measuring attitudes and intentions in agricultural research. In order to ensure accurate interpretation, mean scores and percentages were calculated using the true limits convention. The result is believed to introduce new technology to urban farming and guide policy decisions. As a result, this research will be supporting the Sustainable Development Goals (SDGs), especially Zero Hunger (Goal 2), Sustainable Cities and Communities (Goal 11), and Climate Action (Goal 13), helping cities become more sustainable and resilient.

Keywords:

Agriculture, Awareness, IoT Technology, Urban Farming

Introduction

Nowadays, there is a growing need for systems of sustainable food as cities expand rapidly. As a result, innovation and the use of technology in the agricultural field have become essential to urban farming. However, as mentioned in Thompson and Sorvig (2014), there are major challenges especially with managing resources and limited space in the urban gardening. Therefore, the Internet of Things (IoT) has been applied and is transforming current mini greenhouses into smart and data driven systems (Chopade et al., 2023). It is making a difference for both small home gardens and large farms (Ambong & Paulino, 2020; Dong et al., 2022; Duang-Ek-Anong et al., 2019; Jain & Rekha, 2017; Rathor et al., 2024; Zailan & Abd Hamid, 2025).

In use of IoT integrated mini greenhouse gardens, smart sensors used for monitor temperrature and soil moisture. Besides that, with the using cameras and precise irrigation, improve crop quality and reduce manual labor (Ferrandez-Pastor et al., 2016; Reka et al., 2018). Also, the integrated systems are helpful for image-based monitoring (Wudneh & Vanitha, 2019) and automated vertical hydrophonics (Said et al., 2025).

Although IoT integrated farming is gaining popularity in Malaysia, economic and social barriers still limit the widespread adoption of these technologies (Zharir et al., 2024). Also, the use of technology in agriculture is still uneven in Malaysia. For example, large commercial farms like in the Cameron Highlans has been used the modern tools like automation, 5G and artifical intelligence. While most household and small-scale farmers have not adopted these technologies. The main reasons are the high cost of equipment, unreliable internet and limited

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digital skills. Moreover, urban farming faces several challenges such as limited space, the labor required for traditional farming, unpredictable weather, unreliable water supplies and rising utility costs (Yapp et al., 2025). As a result, most of the urban residents view smart farming as complicated and expensive. To overcome these issues, the Malaysian government has initiated efforts to improve local food security including supporting Smart Urban Farming (SUF) programs such as *Kebuniti* (Community Farming) and National Agrofood Policy 2.0.

Earlier studies mainly focused on commercial farmers and rural smallholders, leaving a gap in understanding for the urban consumers. Also, Omar et al. (2026) and David (1989) use the Technology Acceptance Model (TAM) to investigate the financial risks and benefits in large commercial farms. Therefore, this research uses another model namely the AIDA (Attention, Interest, Desire and Action) model to examine smart farming that focuses on urban areas of Malaysia. Although AIDA is usually applied in marketing (Tristanto et al., 2021) and other social sciences (Li et al., 2025; Hassan et al., 2015), here it is adapted to explore the consumer journey in agriculture, a field that has not been widely studied. The main objective is to investigate the awareness and adoption of IoT integrated mini greenhouse gardens for urban farming in line with supporting the United Nations Sustainable Development Goals (SDGs) for climate action and zero hunger.

Materials And Methods

The survey was conducted in Malaysia from August 14, 2025, to January 31, 2026. Participants were required to be at least 18 years old and reside in urban areas. Results are presented as percentages. The questionnaire was structured according to the AIDA model, which comprises Attention, Interest, Desire and Action. Figure 1 presents an infographic explaining each factor in the model.

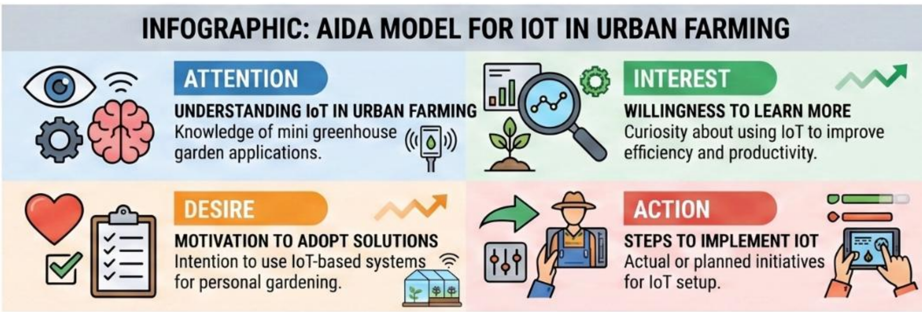

Figure 1: The Infographic Details of Each Factor in The AIDA Model

Research Design and Theoretical Framework

This study used a quantitative, cross-sectional design to assess how ready urban farming practitioners are to adopt an IoT-integrated mini greenhouse. This research uses the AIDA model to examine smart farming in urban areas of Malaysia. As a result, this research determines how aspects like relative advantage and perceived usefulness (PU) will influence the adoption process in the integration of IoT integrated mini greenhouse gardens for urban farming.

Instrumentation and Measurement

The data collected using a structured survey with 20 items. Five items addressed for each AIDA factor namely attention, interest, desire and action. The survey used a four-point Likert scale with 4 for Strongly Agree and 1 for Strongly Disagree. This scale has been used due to its reliability in measuring behavioral intentions and attitudes in the development of the agricultural field. The data were analyzed using percentages and mean scores using the true limits convention described by Lindner and Lindner (2024).

Data Collection and Analysis

The survey has been conducted online and physically focusing on urban areas in Malaysia. For the analysis, descriptive statistics were used to calculate agreement percentages and average scores for each item in the survey. Also, the results were analyzed using the TAM model to identify factors and barries that support wider adoption.

Results & Discussion

Attention Factor

The initial stage of the AIDA model aims to capture the attention of the target audience and raise awareness of how the technology could be useful. This step matters in technology adoption research because it marks the first time potential users encounter the new technology. The attention factor was measured using five indicators (At1-At5) to assess technical uses and resource efficiency in urban farming, as shown in the percentages in Figure 2.

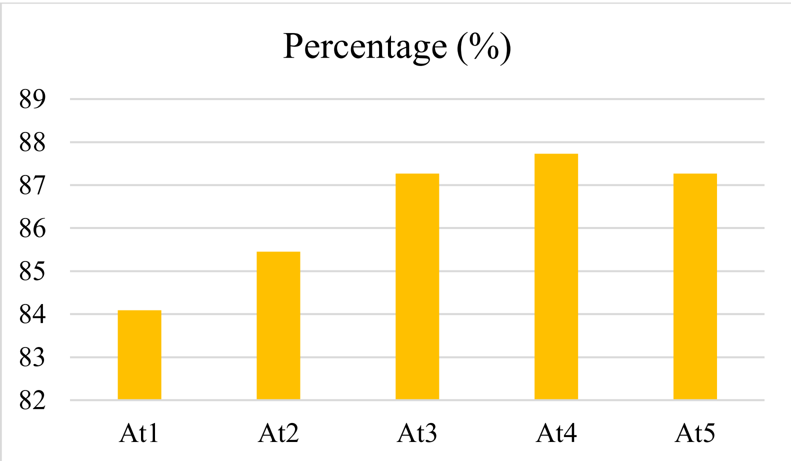

Figure 2: The Percentage of Each Attention Factor

The analysis of the attention factor shows that the strong initial awareness among the urban dwellers on the IoT integrated mini greenhouse gardens, with an average 86.36%. Besides that, item At4 with the highest agreement percentage at 87.73% shows how well the benefits of campaigns of smart farming are perceived. This suggests that the target audience and supporters have been reached by the promotional efforts, and that external communication mainly drives early interest.

Next, the item At1 with 84.09% on understanding the ecological role of IoT and the item At2 with 85.45% on general system information, show that technical understanding is lower than the perceived economic benefits. Most potential users are more interested in cutting costs and saving resources than in how the technology works, as shown in item At3 with 87.27%.

Interest Factor

The transition from basic awareness of a technology to affective involvement has been represented in the interest stage. It has been characterized by curiosity and through the evaluation of its possible utility. This study examined respondents' openness to exploring IoT optimization as a mechanism to enhance productivity and work efficiency.

This stage shows a progression from awareness of technology to deeper consideration and greater interest in possible applications. The evaluation measured respondents' openness to exploring IoT optimization to improve efficiency. The interest factor results, represented in Figure 3, indicate a positive trend, with an average score of 81.98%. The study shows that external influences are the primary drivers of emotional involvement. In particular, smart farming campaigns and awareness programs (In4=84.55%) as well as user experiences and peer testimonials (In5=84.09%) received the highest levels of agreement. The results show that social proof and institutional support remain essential for moving potential users from awareness to active interest, in line with the TAM in collectivist farming communities.

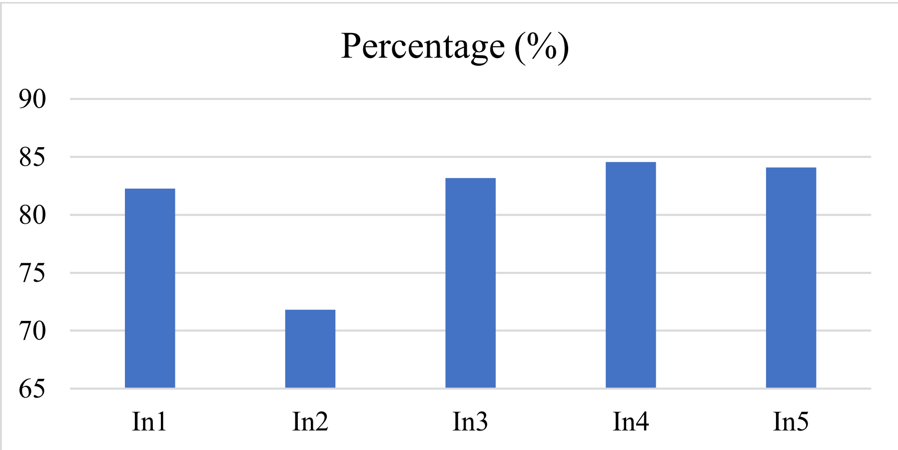

Figure 3: The Percentage of Each Interest Factor

Respondents exhibited substantial curiosity about the potential of IoT to address farming challenges (In3=83.18%) and reported growing interest in its daily use (In1=82.27%). However, these results from the intention to purchase (In2) were lower at 71.82%, suggesting that, despite high levels of interest, most respondents are not yet ready to make a purchase. Therefore, considerations of practicality, including the need for training on hardware use and technical support, appear to influence their decision-making process.

Desire Factor

Figure 4 presents the percentages associated with the desire factor. The desire stage will shift from initial interest in the technology to a personal commitment, driven by its perceived potential and usefulness in addressing specific challenges.

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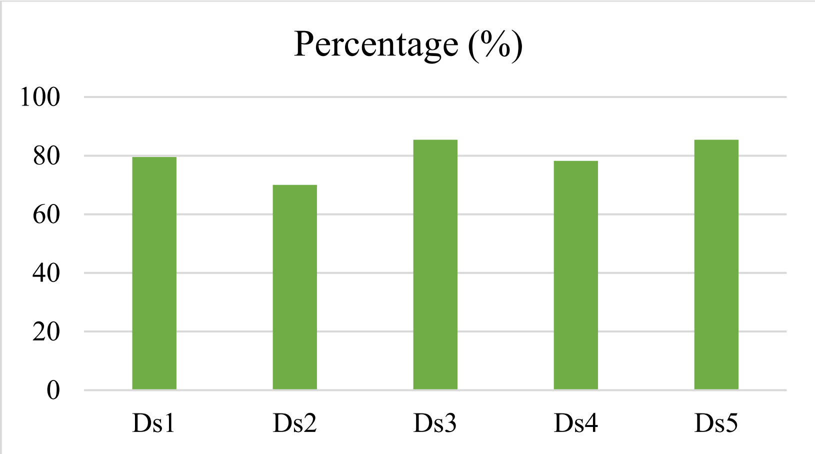

Figure 4: The Percentage of Each Desire Factor

It shows that the main reasons people are motivated are reliability and accessibility with the average score for the desire factor was 78.73%. Besides that, people are more interested when the technology is easy to access and works well every time. This can be seen in items Ds3 and Ds5, which had the highest agreement (84.45%).

While the lowest score is Ds2 (70.00%) indicating that people are still unwilling to make personal purchases. This is evident in the interest stage. Respondents were motivated to learn more technical details (Ds1=79.55%) and were open to changing their farming practices (Ds4=78.18%). Still, they are cautious about actually buying the system. These results suggest that reducing its cost would help people fully commit to and make the technology more reliable.

Action Factor

Figure 5 shows the percentage for each action factor. The action factor represents the final stage in the AIDA process, in which awareness and desire are expected to result in actual system use or purchase. At this stage, individuals are particularly sensitive to logistical and economic challenges, as these involve the commitment of resources.

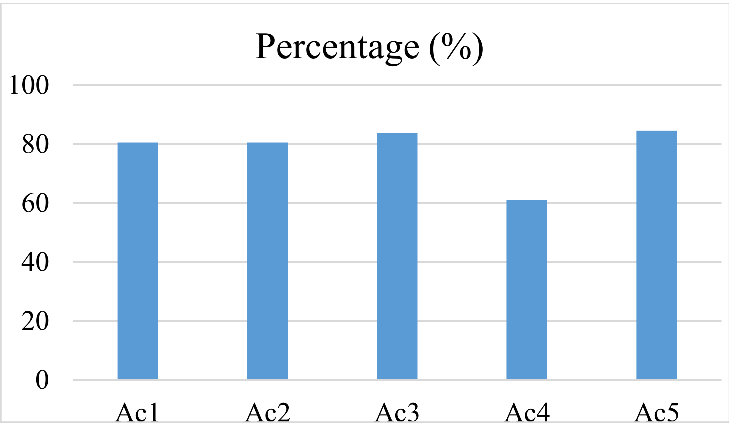

Figure 5: The Percentage of Each Action Factor

The overall mean agreement of 77.60% for the action factor and the lowest in the AIDA hierarchy, shows considerable resistance to taking action. The data show a motivation to switch from traditional agricultural technologies to IoT-based solutions (Ac2 = 80.45%) and strong engagement with the system and efficient use (Ac1 = 80.45%). Still, economic issues are the main issue. In addition, the Ac4 score (60.91%) indicates that people are highly sensitive to high upfront costs. This suggests that high initial investment is the main barrier to adoption, which matches other research showing that small scale urban farmers see this as a major obstacle.

Economic intervention is further shown by item Ac5, which achieved the highest agreement in this factor (84.55%). This show that the adoption is highly responsive to financial subsidies or incentives, suggesting that potential users recognize the technology's value but perceive the entry risk as disproportionate without institutional support. Interestingly, despite their own financial hesitations, respondents showed a strong propensity for peer-to-peer recommendations and advocacy (Ac3 = 83.64%). This highlights a favorable word-of-mouth potential that can be leveraged to build community trust if accessibility barriers are addressed through strategic pricing or incentive programs.

Discussion On AIDA Factors

When analyzing using the AIDA factors, there is a typical funnel effect namely engagement drops as potential users get closer to taking action.

Table 1: Summary of Mean Scores Across the AIDA Hierarchy

Factor	Mean Score (M)	Qualitative Interpretation
Attention	3.455	High Awareness and Cognitive Engagement
Interest	3.247	Moderate to High Curiosity
Desire	3.189	Moderate Motivational Drive
Action	3.120	Moderate Behavioral Commitment

The mean scores for each factor of the AIDA model are shown in Table 1. The scores go down from Attention (M = 3.455) to Action (M = 3.120). Therefore, the main challenge is motivating people to make a purchase. Most people are already interested in and informed about this technology, but many are waiting for better economic conditions or easier access before deciding to buy.

Conclusion

As conclusion, this research investigated public awareness and readiness for IoT integrated mini greenhouse gardens in urban areas in Malaysia. The results of this research show there is a gap in both readiness and awareness. Most respondents acknowledged the potential of IoT in agriculture, but there is lacked a thorough understanding of how the system operates.

Therefore, to address this gap, there is a need for media campaign programs and educational initiatives programs that align with national food security agendas, such as the Kebuniti and Household Kitchen Garden programs. The integration of IoT solutions including automated irrigation and nutrient monitoring, enables urban residents to overcome temporal constraints suitable for high density environments. These smart systems change urban farming to a sustainable and technology driven practice instead of a labor practice. This transformation enhances household resilience and contributes toward a digitally enabled, circular urban economy in Malaysia.

Future studies should use long term research to see how people use smart gardens in their daily lives. In addition, researchers should combine the AIDA model with other frameworks to better understand how factors such as ease of use and social influence affect people's decisions to adopt these systems. It is also important to find ways to lower the cost of IoT kits so that more low-income households in Malaysia can take part.

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Author Contribution Statement:	All authors contributed significantly to the development of this manuscript. Nurhidaya Mohamad Jan was responsible for the conceptualization, methodology, and overall supervision of the study. Siti Munirah Mohd and Amirul Asyraf Zhahir were responsible for the field test to successful. Mohd Ilias M Shuhud and Shafinah Kamarudin handled data collection, analysis, and interpretation of results. Azuan Ahmad and Mohd Zamrus Bin Mohd Ali contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.

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