Research on the Application of the Internet of Things Based on A-IoT

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Abstract. The application of artificial intelligence plus the Internet of things has become the next big trend in the technology industry, due to the development of A-IoT chips and related industries. Several applications such as the smart speaker and smart cars began to thrive, the future 10 years is considered the "golden age for A-IoT" by the technology industry. This essay will be evaluating the current A-IoT application, to construct a driving factor model, later apply two case studise to analyze particular cases, applying the driving factor model of A-IoT applications to give a prediction of the industry.

Keywords: A-IoT · IoT · AI · Case Study · SoC

1 Introduction

The Internet of things has been promoted on a national scale across the globe and is set as the key area for developments and innovations in many countries. The application of the internet of things has integrated with traditional industries, creating products that are composed of smart factors and intelligence. The A-IoT is a rapidly growing technology, that has characteristics such as "high certainty for further innovation" and "high growth rate of market size". Despite the attribute of IoT, on July 3, 2020, the 3rd Generation Partnership Project Rel-17 have been finished, including the field of mid to low-speed NB-IoT into the standards of 5G [1]. This standard sets the internet foundation for the application of A-IoT, making clear the area of development in smart furniture, smart cars, and smart health. Thus enabling the aforementioned A-IoT Applications to thrive, possibly leading to an increase in the factors of earnings and multiple expansion. This paper will be using economic models and theories to analyze the A-IoT application with case studies, constructing a driving factor model for the A-IoT applications.

2 Research Method

This section will first explain the selection of research method, combined with the current A-IoT applications and development, to discuss the reasons behind the chosen structure of the driving factor model. Every research method has its limitations and significance, to decide which method to apply two key questions must be answered, the range of research

and the desired outcome. One of the most popular and recognized methods is empirical analysis, as it is clear in structure, precise in data, and concise in logic. Nevertheless, empirical analysis is limited when attempting to analyze A-IoT applications, as it is based upon the generalization and summarization of particular scenarios and data, A-IoT being a new field of development lacks such particular cases and data. Due to the limitations mentioned above, scholars use the case study as an alternative, which applies to explanatory questions such as "How" and "Why", giving explicit connections between cases provable by research, surveys, and data collection. A case study's target is usually an event that researchers have no or very little control over, having the research being performed under a real-world environment, the area of research. A-IoT fits the property of having no control by the researcher, making case study a suitable research method. Based on the features of a case study this paper will be answering "Why A-IoT is applied" and "How A-IoT is being applied". The Case study design will be following the framework of Yin (1994) [3], beginning from Selecting cases, to collecting data, then analyzing data, and ending with enfolding literature. A multiple case study is more reliable than a single case study, as it requires a sensible theory framework, to state the direction of research, prohibiting the research to be misled.

2.1   Model Construction

This section will formulate the driving factor model for the applications of A-IoT, targeting the current development. The driving factor model will be based upon the technology acceptance model and VRIN Framework integrating both the perspective of enterprises and users to construct an adequate driving factor model for A-IoT. The factors could be categorized into four different areas.

User experience, one of the key variables of the technology acceptance model, could be extended into accessibility and compatibility [5].

Relevant cost is a variable of VRIN Framework, considering the actual cost in the case of A-IoT applications, this would be the cost of production and maintenance for an A-IoT product.

From the study of Michael Porter's diamond model, supply and demand is the determinant factor of whether a product or technology has market prospects. Firms' supply, responsible for providing the product and service, and the market's demand further determine the technology's actual application (Fig. 1).

Based upon the research method and theory model previously constructed, this section will give a detailed introduction and labeling of the chosen case studies. Smart furniture is predicted to be one of the most elastic A-IoT applications, when considering growth, 2019 GfK Temax estimated that the global small household appliance industry sold around 104.4 billion USD worth of goods, smart small household appliances are devoted to improving on state feedback and user interaction. The Chinese smart speaker market has been growing rapidly in recent years, despite being the country with the most users, its penetration rate only reached 10%, compared to America with 26%, and the average of 15% for other countries. China has a great potential in market growth, if in the future it became on par with developed countries with 20%, the smart speaker market will have at least 50% growth rate.[1] Smart speakers are the core operation component
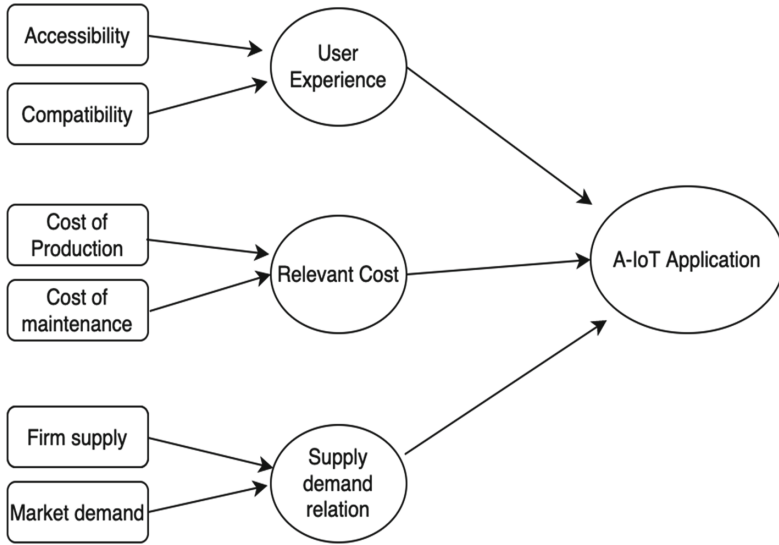
Fig. 1. Detail of the selected case study

for users to interact with smart furniture, as it enables control through wireless connection and voice recognition, which is essential for smart homes. According to data from Canalys, the total sales of smart speakers is around 135 million units across the globe, the 2021 sales are estimated to be 163 million units, having a growth rate of 21% [3]. An important application of A-IoT is on the chip of the smart speaker, through featuring an SoC chip the speaker became capable of performing AI voice processing, allowing a recognition algorithm to be performed, enhancing the user experience on voice recognition. According to data from IDC, the chip takes 35.5% of the entire speaker, being one of the core components for current smart speakers. The leading smart speaker and smart home enterprise in China are MI, according to IDC in 2020's third quarter, MI holds a 16.3% smart household appliance market share. The MI smart speaker has sold 3.8 million units in 2020's fourth quarter, 6% of the market share. [1] (Fig. 2).

This section is a preparation for the case study, introducing the current household appliance industry and the smart speaker industry, demonstrating the importance of smart speakers in smart homes, along with the industry's great potential for growth. Identifying the application of A-IoT in the smart speaker's SoC chip is an essential component for realizing voice recognition and user interaction.

To perform multiple case studies, this paper will continue to evaluate the application of A-IoT in the automobile industry. Smart cars are mainly focused on improving the experience of driver and passenger, including features such as entertainment systems, and driving assistance systems. The entertainment system is mainly composed of a central control unit located on the back seats, while the driving assistance system includes a control panel, head-up display, and touch screen. The vehicle industry has developed on technology, moving from AM/FM to controller area network, USB connection, Bluetooth connection, the displaying and processing of data for automobiles are increasing in

Feature Evaluated	Smart speaker	Bluetooth speaker	Active Speaker
Security	Require ID and Password	Low	Unavaliable
Transmission Distance	100 meters	10 meters	Cable
Delay	150ms	200ms	Cable Distance X 1.1ms
Transmission Speed	54Mbps-150Mbps	20Mbps	unavaliable
Wireless Relay	Avaliable, Could be used as WIFI hotspot	Unavaliable	Unavaliable
WIreless Function	Avaliable, Could be used as WIFI hotspot	Unavaliable	Unavaliable
Transmission Method	Point to Many	Point to Point	Cable
Multiple play task	Avaliable	Unavaliable	Unavaliable

Fig. 2. Comparing Smart Speakers with Bluetooth and Active Speakers

quantity, the A-IoT solution became necessary. In 2020, the total display screen for automobiles has reached 142 million units across the globe, with 73.8 million used for the control unit. The features of the entertainment system have increased, including music, navigation, video, interactions, etc., thus the A-IoT application with service on a chip was applied [1]. The application of SoC ensures the stability, security, and consistency of the automobile system under conditions such as unstable power supply. In addition, the AI modulus provides extra hashing power and algorithm to the central control, enabling autopilot to be performed. Studying the product of Allwinner Technology, a firm set in 2007, its intelligence processing unit series T have applied by Faurecia, a leading supplier in automotive technology, improving the performance of dashcam, smart rear view mirror, and smart dashboard.

2.2 Case Study

This section will perform a case study on the two chosen A-IoT applications, applying the model previously set, and evaluating the applications. The author will be applying a 4 layer classification code for analyzing the cases, the first being the two chosen cases, MI smart speaker and Allwinner Technology SoC chips. The second layer is three key areas previously stated, User experience, relevant cost, supply, and demand. The third is a more detailed classification of the second, with accessibility and compatibility, cost of production and maintenance, supply from the firm, and demand from the market. Fourth is the explanation for the third layer giving details and explanation (Table 1).

3   Future Development

This section will be using the A-IoT driving factor model and considering the current trend in development to filter the areas in which A-IoT could be applied.

Table 1. Features of MI Smart Speaker and Allwinner Technology SoC chips

Feature	MI Smart Speaker	Allwinner Technology SoC chips
Accessibility	1. Connection to the local area network, making it accessible to mobile devices through software. A task could be set using the smartphone and performed on a smart speaker	1. The chip could be put into performance once a task is set through the screen display, it is also automatically activated when enabling autopilot
Compatibility	The smart speaker featured by MI includes AI voice recognition that identifies users under noised background, enabling usage in all households. 2. The software used to control MI speakers is downloadable on all devices, the speaker could also be accessed through the network as it is connected to LAN.	1. The SoC chip by Allwinner Technology is dedicated to the automobile industry. Applicable by any automobile manufacturer
Cost of production	1. The MI smart speaker chips are made by large manufacturers such as Amlogic, ISSI, TI, and CYPRESS, reducing production costs by cutting self-innovation and production lines	1. The SoC chip is designed by Allwinner independently, potentially increasing the cost of production
Cost of maintenance	The MI smart speaker could be disassembled making inspection and repair simple. 2. The speaker could self-detect where the issue is coming from, reducing labor in checking.	---
Supply	1. High supply, as MI smart speaker is the top seller in the Chinese smart speaker industry	1. The SoC chip has a full series with three models, showing a mature manufacturing line.
Demand	1. High demand, the Chinese smart furniture market has only a 10% penetration rate, with a potential of 50% future growth rate, MI smart speaker being the core component of MI smart furniture is certainly high in demand.	1. The growing electric car industry and the trending concept of autopilot make applying SoC chips inevitable in the automobile industry, and the demand for SoC chips will be high.

3.1 Smart City

Smart city's major advantage is support from the government, the current sewer system and street light system in many countries have inefficient use of resources, by having an

A-IoT application could increase the system's efficiency. This area has great potential as it is large in quantity and closely related to every resident. The smart utility hole cover could be applied to monitor the sewer system, whether there is leakage, overflow, or gases beneath the covers, having A-IoT applied will enable detection and analysis of harmful gases such as hydrogen peroxide, this could alter people about potential harm inside the sewer, reducing the cost of labor in checking every utility hole when there is an issue. The smart street light system could use A-IoT to monitor the business of the street, having AI analyze and predict when the road is not busy, shutting down certain lights to reduce electric power used. In addition, the smart street lights could also give information about the current traffic conditions allowing the traffic light to adjust. In conclusion, the smart city is an area that which A-IoT applications have great potential, as there is a large quantity of demand and high support from the government.

3.2 Smart Logistics

Smart logistics has been a popular topic in the recent years, despite having a complete and mature application of A-IoT in the storage and packaging stages, with each product forecasted and sent to local storage centers, the application of A-IoT still has a great potential in the transport and deliver stages, as there have been frequent cases of expensive or important packages being theft, having A-IoT applied as small chip could enable the packages to be monitored under every condition, even when stolen the package could be traced down through the analysis and location that the A-IoT chip has sent. In conclusion, as the logistic demand is increasing across the world, having an A-IoT application in the stages of delivery could reduce the potential of losing an important package, reducing the cost of resolving a package loss case for logistic companies.

4 Conclusion

This essay has begin with the concept of A-IoT, elaborating on the global and national background of A-IoT studies. Through analyzing theories and essays, it has developed a driving factor model of applications of A-IoT, discussing the following area in detail:

The key factors affecting the application of A-IoT are user experience, relevant cost, supply, and demand. The product's accessibility and compatibility affect the user experience, these two factors will determine the A-IoT acceptance. As for the cost of production, this will make the firms determine whether to release and manufacture the A-IoT product, the cost of maintenance will affect whether other firms or consumers will decide to purchase the A-IoT product. The cost and demand will influence if A-IoT is worth implementing, from the firm's view whether to increase in production and from the market's view whether it has a high demand.

The author concluded potential areas of implementing A-IoT, smart city, and smart logistics, giving a detailed explanation of how having A-IoT applied on the street light, manhole covers and delivery boxings could reduce the cost and use of resources.

As the A-IoT technology matures, the development of A-IoT will be rapid, the current economy has already produced a clear and complete habitat for applications. Developing a model for A-IoT commercial applications in specific fields will certainly be helpful for future research.

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