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Research Article

Determining the Drivers and Barriers to the Adoption of Smart Vending Machine

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Abstract

The Internet of Things (IoT) revolution is revolutionizing numerous industries, including the vending machine industry. Smart vending machines are one example of how the Internet of Things is altering the way vending machines operate. Smart vending machines can do functions other than merely dispatching products in exchange for payment by combining modern technologies such as internet connectivity and touch screens. They can make purchasing more convenient for customers, track inventories in real-time, and even take mobile payments using a smartphone app. By surveying 412 business owners, this study employed a stacking classifier to analyze the determinants of smart vending machine adoption. The findings indicate that improved security and safety, as well as the decrease in operational costs, are the primary drivers of adoption among firms that have adopted the smart vending machine. Smart vending machines can be equipped with security cameras and alarms to deter theft and vandalism, as well as to prevent contamination or tampering. This can help to improve the vending machine's general security and safety, as well as the products it dispenses. By automating processes such as inventory management and refilling, smart vending machines can also help to minimize operating expenses. This can save the operator time and money. This study's findings also revealed that the primary barriers to adoption are upfront costs and technological challenges. The initial cost of purchasing and installing a Smart vending machine might be too expensive, particularly for SMEs. Operators may be required to spend on technical help and training in order to successfully use and maintain this equipment. The future of vending machines is expected to witness a steady move toward Smart vending machines. As sophisticated technology becomes more widely accessible and inexpensive, more operators are likely to realize it and make the switch.

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Introduction

In recent years, there has been a growth in the usage of "Smart vending machines," which are fitted with cutting-edge technology such as internet connection and touch displays. One example of how the Internet of Things (IoT) is transforming the way that vending machines work is the rise of smart vending machines [1], [2]. Smart vending machines are able to carry out a variety of functions in addition to dispensing items in return for monetary input, as a result of the incorporation of cutting-edge technology such as internet connection and touch displays. They are able to provide clients with a more comfortable shopping experience, keep real-time track of inventories, and even take mobile payments via the use of a mobile application. These robots have a broader variety of capabilities than merely dispatching items, and they have the ability to improve the whole customer experience, boost sales and income, improve security and safety, and cut operational costs.

Traditional vending machines, often known as vending machines, have been around for decades and distribute items in return for a payment. These vending machines are often located in public settings like airports, malls, and workplaces, and they provide a range of products for customers to purchase, including snacks, beverages, and even little presents. Customers may find conventional vending machines handy, but these machines have a number of drawbacks and are not as efficient as they may be.

The inability of typical vending machines to take a diverse variety of payment methods is one of the most significant drawbacks of these devices. Customers who either do not have cash on hand or who would rather pay with a card may find it hard to use conventional vending machines, which only take cash as a form of payment. Because they are often filled with pre-packaged commodities that have a lengthy shelf life, conventional vending machines are sometimes restricted in the kinds of products that they are able to distribute. The selection of things that buyers may buy is narrowed as a result of this.

Traditional vending machines, on the other hand, are inefficient when it comes to the administration of their inventories and the replenishment of their supplies. It is the responsibility of the operators to manually maintain inventory levels and refill the machines as necessary; this may be a time-consuming and labor-intensive process. Additionally, typical vending machines are susceptible to being stolen from or vandalized, which may further impair the profitability of the business.

A "Smart vending machine" is a specific kind of vending machine that is outfitted with modern technology, such as internet connection and touch displays, which enables it to carry out additional functions in addition to just dispensing things that may be purchased from it [1], [3], [4]. The capacity to take numerous forms of payment (such as cash, credit, debit, and mobile payment), providing tailored product suggestions, and tracking inventory in real-time are just some of the functionalities that a Smart vending machine could offer.

The use of smart vending machines has a number of potential advantages. One of their most significant advantages is the better experience that they provide for their customers. Customers are

able to enjoy a shopping experience that is both more convenient and more productive thanks to innovative technology that is included into smart vending machines. Consumers may, for instance, be able to browse and buy items using a touch screen on a smart vending machine. Alternatively, customers may use a mobile app to browse and purchase things remotely, and then have those products dispensed at the machine [5], [6]. Additionally, intelligent vending machines have the ability to provide individualized product suggestions to customers based on the customers' previous purchases or preferences, which might motivate customers to make additional purchases.

The possibility for improved sales and income is one more advantage that may be gained by using smart vending machines. Smart vending machines are able to attract more consumers and promote sales by providing a more convenient shopping experience as well as an expanded selection of items to choose from. In addition, smart vending machines may be programmed to upsell more expensive items or cross-sell complementary products, both of which can contribute to an increase in income.

Additionally contributing to increased safety and security are intelligent vending machines. For instance, they may be outfitted with surveillance cameras and alarms to prohibit acts of vandalism and theft. Additionally, they may be programmed to distribute only items that are properly packed and unopened in order to avoid the risk of contamination or tampering.

Last but not least, the use of smart vending machines may assist in the reduction of running expenses by automating processes such as inventory management and replenishment of supplies. This might result in the operator saving both time and money on labor expenditures.

Drivers and Barriers

This study tested the roles of various drivers and barriers to adoption. The drivers include the following:

1. Improved customer experience: Customers may benefit from a shopping experience that is both more convenient and more efficient due to the introduction of intelligent vending machines. Customers may quickly explore items and make purchases because of modern technology like as touch displays and access to the internet. Customers can even utilize mobile applications to make purchases from a distance. Additionally, intelligent vending machines have the ability to provide individualized product suggestions to customers based on the customers' previous purchases or preferences, which might motivate customers to make additional purchases.

2. Increased sales and revenue: Smart vending machines are able to attract more consumers and promote sales by providing a more convenient shopping experience as well as an expanded selection of items to choose from [7]. In addition, smart vending machines may be programmed to upsell more expensive items or cross-sell complementary products, both of which can contribute to an increase in income.

3. Enhanced security and safety: Smart vending machines may be outfitted with surveillance cameras and alarms to prohibit acts of vandalism and theft. Additionally, these machines can be configured to deliver only items that are correctly packed and unopened, so preventing acts of contamination or tampering [8], [9].

4. Reduced operating costs: The operator of a smart vending machine may save time and money by automating processes like as inventory management and refilling with the use of the vending machine's capabilities. The cutting-edge technology that is used in Smart vending machines also has the potential to cut down on the expenses of maintenance and repairs.

While there are a great number of drivers for using smart vending machines, there are also a number of obstacles that need to be cleared up before they can be used on a widespread scale. There are several obstacles standing in the way of widespread implementation of smart vending machines, including the following:

1. Upfront costs: When compared to more conventional vending machines, the initial cost of acquiring and installing a Smart vending machine may be rather significant. This can provide a problem for certain operators, particularly those who own small enterprises or have limited access to financial resources.

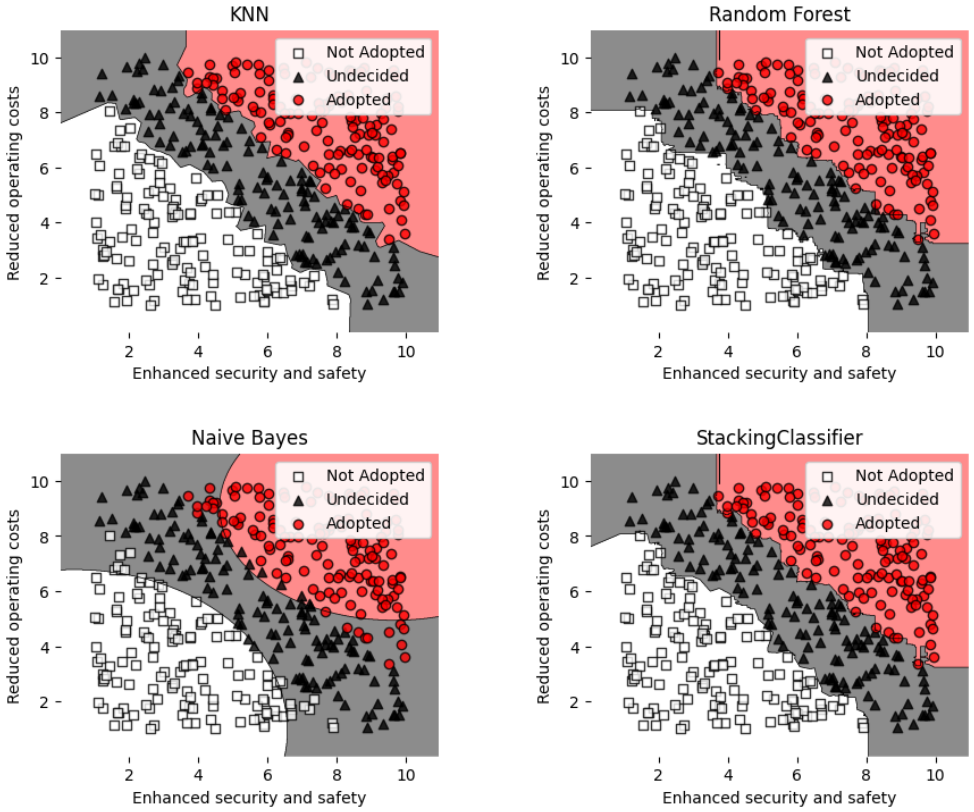
2. Technological challenges: Smart vending machines depend on cutting-edge technology, which might be difficult to understand and operate smoothly at all times. In order for operators to efficiently utilize and maintain this equipment, it is possible that they may need to make an investment in technical assistance and training [10], [11].

3. Resistance to change: It is possible that some operators may be reluctant to accept new technologies, particularly if they are used to the operation of conventional vending machines and are at ease with the manner in which they function. A learning curve may be linked with the use of smart vending machines, and operators may need to be persuaded of the advantages of employing these machines in order to overcome their aversion to change [12], [13].

Results

This research used stacking classifier machine learning algorithms [14], [15], using the survey data from 412 business owners across the world. to The results of stacking classifier are reported in figure 1, figure 2, and figure 3. It can be seen from figure 1. that the adopters (red region) are the participants who think there is are benefits of reduced operation cost and security and safety. The participants in the gray region are undecided, and the participants in the white region have not adopted the smart vending machines. The similar description is valid in case of barriers in Figure 2. The accuracy scores are presented in Table 1. It shows that the Stacking and the KNN classifiers have the highest accuracy scores.

Figure 1. Significant drivers



It is often assumed that the advantages of using Smart vending machines outweigh the disadvantages. While these machines have certain initial expenses and technical obstacles, the potential for higher sales and profitability, better customer experience, increased security and safety, and lower running costs make them a desirable investment for many operators.

One significant driver of smart vending machines is their capacity to enhance the consumer experience. Customers may quickly explore and buy things using modern technology like as touch displays and internet access, and they can even utilize mobile applications to make transactions remotely. Smart vending machines may also provide customized product suggestions based on a customer's previous purchases or preferences, encouraging repeat business.

Another driver is the possibility of increased sales and income. Smart vending machines may attract more consumers and promote sales by providing a greater selection of items and a more comfortable shopping experience. Furthermore, smart vending machines may be programmed to upsell or cross-sell similar items, thereby increasing income. Smart vending machines may also

improve security and safety by including security cameras and alarms to discourage vandalism and theft, as well as being programmed to distribute only properly packed and unopened items to avoid contamination or tampering.

Figure 2. Significant barriers

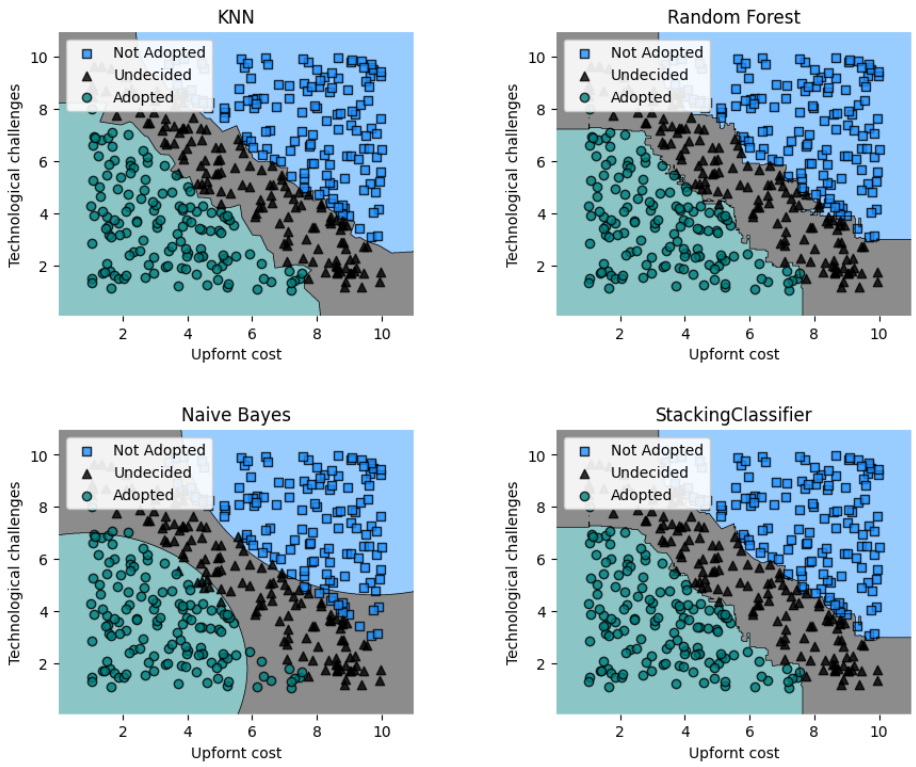


Table 1. 3-fold cross validation:
Accuracy: 0.94 (+/- 0.01) [StackingClassifier]
Accuracy: 0.94 (+/- 0.02) [KNN]
Accuracy: 0.92 (+/- 0.02) [Random Forest]
Accuracy: 0.89 (+/- 0.01) [Naive Bayes]

Finally, by automating processes like as inventory management and refilling, Smart vending machines may assist to cut operational expenses. This may save the operator time and money. While there are certain hurdles to implementing Smart vending machines, the potential advantages make them a viable investment for many operators.

There are numerous methods available to assist overcome the hurdles of using Smart vending machines. Exploring finance possibilities is one answer to the problem of upfront fees. Some Smart vending machine manufacturers provide financing or leasing alternatives, allowing operators to spread the expense of acquiring and installing these devices over time. Operators may need to spend in technical assistance and training to overcome technological obstacles. Purchasing maintenance contracts or employing specialists to handle repairs and upgrades are examples of this. Furthermore, many firms that sell Smart vending machines provide training and support services to assist operators get familiar with these devices.

Operators may need to be taught on the advantages of Smart vending machines in order to overcome reluctance to change. This may be accomplished via marketing and education campaigns that emphasize the benefits of these equipment, such as higher sales and revenue, better customer experience, greater security and safety, and lower running costs. Operators may be more motivated to embrace Smart vending machines if the value of these devices is shown. The future of vending machines is expected to witness a steady move toward Smart vending machines. As sophisticated technology becomes more widely accessible and inexpensive, more operators are likely to realize the advantages of using these equipment and make the move.

Customers' increased need for convenience and efficiency is one element driving this transition. Smart vending machines provide a more comfortable shopping experience by accepting numerous means of payment, providing individualized product suggestions, and even allowing remote purchase using a smartphone app. Customers may grow more inclined to seek out and utilize Smart vending machines as they develop acclimated to this degree of ease. Another consideration is the possibility of increased sales and income. Smart vending machines, with their expanded product offerings and tailored suggestions, may attract more consumers and increase profits. Furthermore, the option to upsell and cross-sell similar items might increase income. Finally, Smart vending machines may be appealing to operators due to their lower running costs and better security and safety. Inventory management and restocking may be automated to save time and labor expenses, and improved technology can assist to decrease maintenance and repair costs. Overall, it is evident that a transition toward Smart vending machines is already occurring, and it is likely to continue as these machines become more common and their advantages are more understood.

Conclusion

To fully realize the promise of Smart vending machines, operators must handle the hurdles associated with their adoption. By overcoming these obstacles, operators may assure that they can reap the advantages of Smart vending machines, such as greater sales and revenue, better customer experience, increased security and safety, and lower running expenses. The initial expense of implementing Smart vending machines is a significant barrier to adoption. While the initial cost of acquiring and installing these devices might be substantial, financing alternatives are available to assist operators in spreading the expense over time. By investigating these alternatives, operators may guarantee that they can afford to acquire and install Smart vending machines.

Another difficulty is the technical sophistication of these devices. Operators may need to invest in technical assistance and training in order to utilize and maintain Smart vending machines successfully. By locating these resources, operators can guarantee that they can utilize and maintain these devices properly, reducing the likelihood of glitches or other technical concerns.

Finally, in order to properly use Smart vending machines, operators may need to overcome change aversion. This may be accomplished by marketing and education campaigns that emphasize the advantages of these equipment, such as higher sales and revenue, greater customer experience, increased security and safety, and lower running costs. Operators may be more motivated to embrace Smart vending machines if the value of these devices is shown. Smart vending machine adoption is anticipated to continue as IoT becomes more prevalent and the advantages of linked devices become more generally acknowledged. Traditional vending machines are expected to be replaced by smart vending machines as more gadgets connect to the internet, since the latter provide a broader variety of features and a more efficient and pleasant purchasing experience.

References

[1] K. Kim, D.-H. Park, H. Bang, G. Hong, and S.-I. Jin, "Smart coffee vending machine using sensor and actuator networks," in *2014 IEEE International Conference on Consumer Electronics (ICCE)*, 2014, pp. 71–72.

[2] M. Raskin, "The law and legality of smart contracts," *Geo. L. Tech. Rev.*, vol. 1, p. 305, 2016.

[3] S. Pongswatd, K. Smerpitak, and T. Thepmanee, "Smart coffee vending machine based on IoT concept," *International Journal of Innovative Computing, Information and Control*, vol. 16, no. 4, pp. 1441–1448, 2020.

[4] T. A. Edwan, A. Tahat, S. Hammouri, L. Hashem, and L. Da'boul, "An intelligent and automated approach for smart minimarkets," *International Journal of Computational Intelligence Systems*, vol. 13, no. 1, p. 852, 2020.

[5] A. P. Bodhale and J. S. Kulkarni, "Beverages in Dispenser Machine According to Capsule Identification with Barcode," in *2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA)*, 2017, pp. 1–6.

[6] D. Istrefi and E. Zdravevski, "Making vending machines smarter with the use of Machine Learning and Artificial Intelligence: Set-up and Architecture," in *UBT International Conference*, 2020.

[7] S. V. Hua and J. R. Ickovics, "Vending Machines: A Narrative Review of Factors Influencing Items Purchased," *J. Acad. Nutr. Diet.*, vol. 116, no. 10, pp. 1578–1588, Oct. 2016.

[8] A. M. Wyglinski, X. Huang, T. Padir, L. Lai, T. R. Eisenbarth, and K. Venkatasubramanian, "Security of Autonomous Systems Employing Embedded Computing and Sensors," *IEEE Micro*, vol. 33, no. 1, pp. 80–86, Jan. 2013.

[9] S. Chari, P. Kermani, S. Smith, and L. Tassiulas, "Security Issues in M—Commerce: A Usage—Based Taxonomy," in *E-Commerce Agents: Marketplace Solutions, Security Issues, and Supply and Demand*, J. Liu and Y. Ye, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2001, pp. 264–282.

[10] A. Rusdiansyah and D.-B. Tsao, “An integrated model of the periodic delivery problems for vending-machine supply chains,” *J. Food Eng.*, vol. 70, no. 3, pp. 421–434, Oct. 2005.
[11] G. Lawton, “Machine-to-machine technology gears up for growth,” *Computer* , vol. 37, no. 9, pp. 12–15, Sep. 2004.
[12] J. R. Sprague and R. H. Horner, “The effects of single instance, multiple instance, and general case training on generalized vending machine use by moderately and severely handicapped students,” *J. Appl. Behav. Anal.*, vol. 17, no. 2, pp. 273–278, Summer 1984.
[13] M. Deru, P. Torcellini, K. Bottom, and R. Ault, “Analysis of NREL cold-drink vending machines for energy savings,” National Renewable Energy Lab. (NREL), Golden, CO (United States), NREL/TP-550-34008, Jun. 2003.
[14] G. Sakkis, I. Androutsopoulos, G. Paliouras, V. Karkaletsis, C. D. Spyropoulos, and P. Stamatopoulos, “Stacking classifiers for anti-spam filtering of e-mail,” *arXiv [cs.CL]*, 19-Jun-2001.
[15] R. Florian and JOHNS HOPKINS UNIV BALTIMORE MD CENTER FOR LANGUAGE AND SPEECH PROCESSING (CLSP), “Named entity recognition as a house of cards: Classifier stacking,” JOHNS HOPKINS UNIV BALTIMORE MD CENTER FOR LANGUAGE AND SPEECH PROCESSING (CLSP), Jan. 2002.