

Iot Application Based Advanced Shopping Trolley

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Abstract: Reducing the time consumed while waiting in long queues during the checkout process in a supermarket is one of the core objectives in improving the shopping experience of customers. In this paper we propose the use of RFID embedded with the shopping cart to design a smart shopping system. All the shopping carts in the mall are coupled with RFID tags. When a product which also has an RFID tag is placed in the cart the billing information with respect to that cart is updated by reading the details of the respective product. The malls are installed with smart shelves which are also coupled with RFID readers. This will help in maintaining an inventory list of all the products in the mall and hence improve stock maintenance. In addition to this setting, an LCD display is also installed in the cart which displays the details of available products in that cart and the overall price of all the items. A mobile Point of Sale is maintained in the cart so that the customer can make the payment without actually having to wait in a long queue for the checkout process. All the processed information is maintained in a database so that it be used for analytical purposes in the future.

Keywords: RFID, Wi-Fi Module, Android, LCD

I. INTRODUCTION

In this era, of modernization, Internet of Things or IoT, different interactions among all physical materials have been assigned to real life situations. Each day materials are equipped with various computing functions and communicational functionalities, which allows materials every place for connecting. These updates had brought a very new spin in all the industries, finance department, and all environmental mechanisms, it had provoked great challenge in data managing, mobile wireless communication and Real-life decision making. In addition to that, inexistence of security and lack of interruption issues had already emerged to and very lightweight cryptographic methodologies came in very high amount of requirement to fix into smart IoT applications. There were always a lot IoT using application and devices which changed the whole technology revolution, for example, savvy homes, e-wellbeing frameworks, wearable gadgets. In this journal-paper we proposed a modern smart secure market shopping system using the modern Radio-Frequency-ID technology, which has not yet been very much observed previously. We had considered the security and protection issues identified with shopping frameworks as no past research had handled it properly. In such sort of frameworks, remote correspondences among the different servers, trucks, and things are defenceless against different assaults, a foe can meddle with all interchanges if no legitimate and security functional strategy is connected. Security problems likewise exist including similar framework the contender of any store may get simple access to the flow of items for budgetary procedure. Moreover, client inclinations can be gathered by effectively gathering the item data in customers' shopping baskets. Instinctively this brings the accompanying advantages.

II. RELATED WORKS

Different studies on Internet of Things applications and different works is a hot topic in recent time, but smart and secure shopping systems have not been much well-tested. There had been few research work in few years regarding the improvement for the shopping experience. In 2011, an idea to track the customers was proposed and implemented in the store and find their area of interest for offering personalized coupons. The idea behind modern smart shelves and that of modern smart cart were also been discussed in their works. Modern smart cart can be also tracked and located using the recent RFID methodology and the smart modern shelves can also screen the locations and status of all different items. There had been several attempts made in the year of 2003 to 2018. Shanmugapriyan also proposed a simple method using RFID tag and a QR reader for proper identification of the products, by using the systems that are based on plain and finite fields, like the RSA, as the method requires small key size to give an equivalent level of security system depending on the plain and the finite field, like the RSA technology.

Let F represent the field of integer, module p and elliptic curve E over the F can be defined by using below equation

$$y^2 = x^3 + ax + b \quad (1)$$

Where ' y ', ' x ' $\in F$ and ' $4a^3 + 27b^2 \not\equiv 0 \pmod{p}$ '. The collection of different point on elliptical lines which form a collection and Fig. 1 represents the exact geometrical add function for adding p and q , that is if and only if we create a simple line that passes through p and q , then, the line will definitely cross at a third different point on the curved line ' R ', and the reverse of that point, is the resultant for summation for p and that of q . The main thought behind different works of operations is the three simple points, that is, q , r and p will be completely aligned to on that specific curved line and different points which forms the cross-section of the process with sum of curve equals zero.

Let's suppose that is elliptic line of curve which is drawn on the finite field F , and i is the point in $i(F)$ with prime order n . For generating a pair of public set value key, a periodic subgroup of $E(F)$ will be generated by ' P '.

$$\langle P \rangle = \{\infty, P, 2P, 3P, \dots, (u-1)P\} \quad (2)$$

A private set of key that is uniform and random in the interval of $[1, u-1]$, will be created, selected and then the respective public key is:

$$Q = dP$$

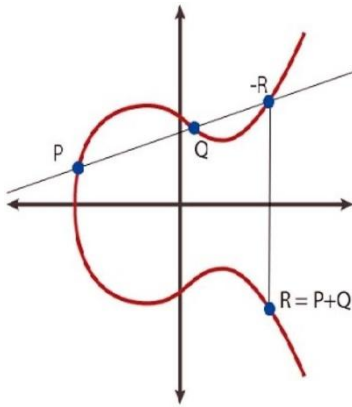


Fig. II.1 Law Grouping on elliptic curve.

III. LITERATURE SURVEY

In the project, we will be discussing about many documents found out by studies and the research which is very crucial and have very much important set of value in reference of the paper. It also gives some simple knowledge or the theoretical bases and it is useful for the foundation to retrieve main target for the work. Many of these surveys are of relevant books, article, previous works and journal of same type. All these surveys are then compiled to and used as of guidance for the work of this paper. The RFID is very feasible, more novel, and very much effective-cost member for everyday object identification but, also very much considerable as important item to give trace-able data visibility, along the many different stage of operations supply chain. The air luggage handling applications, the RFID tags can be used to upgrade the ability for tracking different bags, dispatching, convenience for improvement of the management efficiency and different users' satisfactions. We went through currently available related work and is introducing the latest IATA RP1740 protocol to be used by the standards to figure out the item tags. Among many distributions of aviation bag trackable application that is created depending on modern-RFID networks. We had described the modern RFID-basis bag locating method applied in many airports.

At any point when a client strolls into a store, he/she needs to locate the particular items that he/she needs to purchase. This normally is finished by either asking a store partner or taking a gander at the store signs. Ordinarily, this hunt is very tedious and wasteful. In some cases the client may even surrender the pursuit.

What is required are progressively proficient ways for clients to find and decide the accessibility of items inside a store. Strategies and framework are revealed in this that addresses the previously mentioned issues and makes client shopping encounter increasingly productive and practically easy. Usually for a buyer to utilize shopping baskets rather than hand-holding crate while we are doing his shopping, in a discount shop or a Super-markets, just in light of the fact that it is helpful and work sparing, yet in addition since it can convey a greater number of things than that of the bin in one shopping trip. As of late, alongside the development of RFID innovation, connecting RFID gadgets for a shopping basket for encouraging the activities at every checking-out counter, had been proposed and that use of modern RFID innovation is seen.

A Radio Frequency electromagnetic wave or Radio Frequency "field" comprises of both the electric and an appealing part electrical-field and alluring-field. It normally benefits to provide the power of the Radio Frequency condition at the certain zone similarly as units unequivocal for each portion. Another simple unit used for portraying a Radio Frequency electromagnetic field is "control thickness." Power thickness is described as the power per unit of region. For example, control thickness can simply be conveyed similarly as milli-watts per square of centimeters (mW/cm) or in terms of microwatts per square of centimeters (LW/cm). Concerning the frequencies that are in micro-wave broaden and is high, control thickness typically to express the power. Agreeing, as decided in the security rules between the 800-900 MHz go, the shielded level of Radio Frequency is 1000 uW/cm. additionally, the prosperity rule controlled by the Directorate General of Telecommunications, Minister of the Transportation and Communication is recorded in the tabular representation later on. Imaging for each shopping crates in different shop is outfitted, withan item ceaselessly transmitting Radio-Frequency banner, every client in shop is considered to get overdosed electromagnetic wave adequately, which can be heartbreaking and is also substantial for all arrangement individuals among different stores also. Besides, since RFID gadget appended on a shopping basket will devour control, it requires to be send to the shopping basket to an upkeep area for charging, that is, the process to do something in good condition, such that the store should set up much all the shop baskets and a bigger space to put away the equivalent. Furthermore, it is feasible for a Radio-Frequency-ID gadget of different shop basket to come up short on power while the shopping basket is being utilized by a customer, in a bad position for customer as well as the store. It is likewise a thought that all the unequalled power on RFID gadget is misuse of vitality and certifiably neither smart thought for natural protection.

IV. EXISTING SYSTEM

There is a system for manual billing which had been followed in every transaction market places, where it uses barcode of every product for billing which had been carried out by barcode reader. These systems required manual operation, so human staffs are required for its functioning. Each product being sold may be of lower cost but the total expense a company make for the selling is higher and getting the product detail exactly is difficult and time consuming at the same time.

A. Drawback:

- Works only in short range
- After complete shopping, we have to pay in general way
- Admin can't see product details
- Labor is high.

V. PROPOSED SYSTEM

The planned methodology automatically asks for a client based on RFID. In shopping malls or supermarkets, the merchandise are supplied with modern RFID tags rather than bar-codes. The different trolleys



embrace the setup which includes modern RFID reader, Infra-Red sensor, door with motor, relay, normal GSM module, LED, LCD, data input device and an electrical switch.

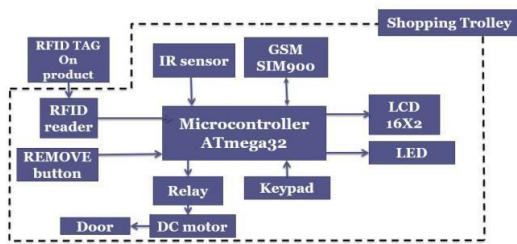


Fig.V.1. Block Diagram of the proposed model

Sensible RFID cards are given to customers for his or her distinctive identification

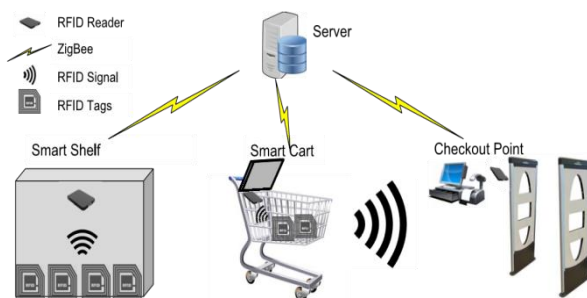


Fig. V.2. System model

Micro-controller: ATMEGA32 is employed wherever it's an eight bit AVR based architecture machine. It operates at 4.5 to 5.5volts DC. It's a 40 pin PDIP with xxxii programmable I/O lines. It consists of non-volatile 32kB of in-system and self-programmable flash, 1024B variant EEPROM and 2kB variant of internal SRAM. Its options like timers, A/D converters, PWM and serial interface. Process speed ranges zero to 16MHz. thus it stores the directions and method consequently. Purpose of microcontroller is to regulate the full method continuously in a repeated manner.

RFID tags: These tags comprise of a semiconductor device for storage of its distinctive range and a coil that acts as an antenna for diverging its hold on information. It should or might not have electric battery relying upon its sort either active or passive severally. Passive tags are used that doesn't have electric battery. As presently because the tag comes within the RFID reader coverage vary, Reader emits radio signals which supplies power for passive tags and it re-emits the radio based signal with information to the reader. Purpose of RFID tags is to unambiguously establish merchandise.

RFID reader: EM-18 is employed that operates at 5volts DC and fewer than 50mA. The frequency at that it works in 125 kHz. It will cover a distance of 10cm. It ceaselessly emits RF signals throughout its range and whenever an RFID tag is within its area, it retrieves the knowledge held on within the tag. Purpose of RFID reader is to retrieve the merchandise information from their RFID tags.

Infra-Red device: It's an object detection sensor. It operates in frequency range of 300GHz to 400THz and wavelength range of 700nm to 1400nm. It's a photodiode and a semiconductor diode. The semiconductor diode emits IR varying to a specific distance relying upon the production parameters and whenever there's a mirrored image of emitted light due to an obstacle, it gets detected by the photodiode. Purpose of IR device is to count the objects getting into the streetcar for preventing felony.

LCD: It's a type of liquid display. It consists of 2 rows and sixteen columns. Every part of display has a row or a column, that successively has eight rows and 5 columns called constituent. It has got sixteen pins wherever information is fed through eight pins only. The provision voltage ought to be 5volts. The registers confirm the correct functioning, specifically information and command. Information register takes ASCII (American Standard Code for Information Interchange) values for characters to be displayed. Command register takes values for creating useful changes like backlight distinction, pointer position etc. Purpose of LCD is for displaying information to the client like welcome note, product catalogue, product details, invoice etc.

DC motor: A DC motor is employed that has an operative voltage of 12volts and 0.5A. The frequency of rotation is around one hundred fifty to two hundred rpm (revolutions per minute). The gear motor has the additional ring with teeth like projections hooked up to the shaft of the motor to confirm uniform speed throughout the rotation of the rotor. Purpose of DC in motor is for correct gap and shutting of the streetcar door.

Motor driver: Motor driver could be a setup that has 2 input offer and a ground. One offer for circuit and alternative to pass to the motor. We have a tendency to used driver circuit that is capable of dominant motor rated up to 12volts. Purpose of motor driver circuit is to regulate the motor.

Keypad: Numeric data input device is employed thought of as a matrix that has four rows and three columns with numbers '0' to '9' and symbols asterisk '*' and hash '#'. Every row and column is connected with a wire and it consists of entirely seven wires. The columns are continuously kept high and rows are kept low. Thus whenever a secret is ironed in row and column at that position, it gets in reality that successively makes the row high and that corresponding part. This is detected, counting on the row and column index. Purpose of numeric data input device is for user inputs like countersign entry, choosing choices like viewing product catalogue, end looking and generate invoice.

GSM module: GSM – international System for Mobile communication. GSM sim900A sort module is employed that incorporates an offer voltage within the vary of 3.4 to 4.4volts. It will operate in four bands of frequency (850/900/1800/1900 MHz). GSM principally utilizes 850 and 900 megacycle per second frequency. It's the flexibility to transmit info within the kind of

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voice (call), text (Short Message Service) and information (GPRS – General Packet Radio Service). Purpose of GSM is for causing alert for unauthorized usage and invoice within the kind of text as an SMS to corresponding user.

Push button:An electric switch typically resembles a switch which is able to turn out high output once ironed and low when it's free. Purpose of electric switch is to alter and take away connection from the devices.

LED:It is Light Emitting Diode, which emits light on an average of around 5volts. It's a kind of contact diode. Wherever it emits light, it recombines holes and electrons. Purpose of a semiconductor diode is to be cautious as product count between RF and IR varies.

Power Adapter: The ability of adapter is employed for dc offer to the setup. It acts a rectifier wherever it takes input of concerning 240volts AC and thirty amps and provides output of 12volts DC and 1 amp which is able to be appropriate to our setup. Purpose of power adapter is to supply a gentle DC supply from an AC power supply.

QR Code:It is the Quick-Response Code or QR code is the double-dimensional matrix representation of bar-code, which is basically used to scan and fetch the details embedded in that QR code. QR generator is used to embed the user details in the QR code. In our project, the QR code is used to provide facility for scanning and fetching the user details and redirect to the bank for processing the payment through the payment gateway as set by the shopping mall or the code providing organization. QR code can be scanned from manual QR reader or from QR scanners available in android devices and reduce the time consumption and faulty path generation during payment processing.

Machine Learning: Machine Learning or ML is in great use now a days in different variants of intelligent systems and smart system architectures. For our paper, we are using the ML to get into the shopping trolley and use the relevant user's transaction details to find a set of recommended item for the buyer in the shop. Here we are using the customer-demographics of the customer for implementing the ML-algorithm. First, we are sorting the customer in groups according to their area of interest in shopping. Then we are using the sales transaction details of the customer to fetch the choice of list for the recommended items in the shopping trolley. We are basically using different clustering algorithms like the K-Means or the K-Nearest Neighbor algorithm to create separate groups. For the user's recommendation.

```
searchItem=001
recoList=itemAffinity[itemAffinity.item1==searchItem]\
    [{"item2", "score"}]\
    .sort_values("score", ascending=[0])

print("Recommendation| for item 001\n", recoList)
```

Fig. V.3 Search Code getting recommended items

The process can be a combination of modules whereas client authentication is that the one with that it gets started. Thus first client is supplied with a sensible card that is RFID enabled. To start out looking client ought to take

streetcar and to assign it to him, by validating his positive identification through the modern RFID reader gift within the trollies. After correct scan, the guy is asked to update with his countersign for purpose of authentication within the LCD. Thereby on entering an accurate countersign victimization data input device then he will begin looking alternatively. If he fails to enter a correct password for three attempts, then the cardboard gets secured and an OTP (One Time Password) is distributed to customer's registered mobile using GSM module. This helps in preventing deceitful usage of sensible cards. When authenticating, client details are displayed together with their total balance on the market in their card so that, he/she is allowed to start out looking. There's a possibility for product catalogue that the client will press asterisk '*' within the data input device which successively displays the information to the market merchandise and their corresponding shelves in a LCD. Client starts looking and he scans merchandise with RFID tag within the RFID reader that initiates motor by means that of relay for gap the door of the streetcar and also the scanned product is made into the trolley. Within the meanwhile, LCD displays the main points of the merchandise and total price accumulated within the purchase. Throughout this method IR device works backend in parallel mode that identifies the count of merchandise. This helps the cross verification within the range of merchandise scanned and number of products. If the count of scanned merchandise and count of products match, it arise a caution by means of a light emitting diode. This helps to avoid dropping merchandise accidentally that don't seem to be scanned and in preventing the felony. Therefore, the method repeats till client finishes Shopping. Once a client takes away a product, electric switch ought to be ironed, which initiates takes away operation. Specified door opens and merchandise is removed by doing rescanning and satisfying the condition that the scanned product id would be already within the purchased list. Throughout this take away method the price of product that is removed is ablated from the entire cost and LCD displays the updated cost.

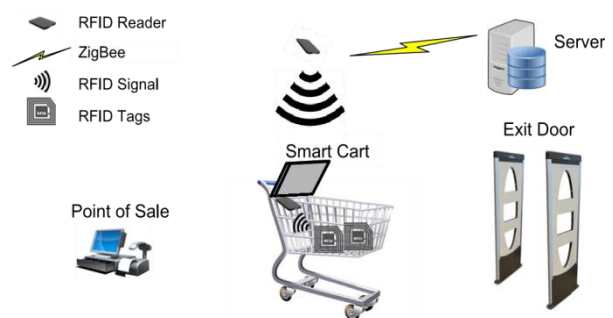


Fig. V.4. Working of the proposed model

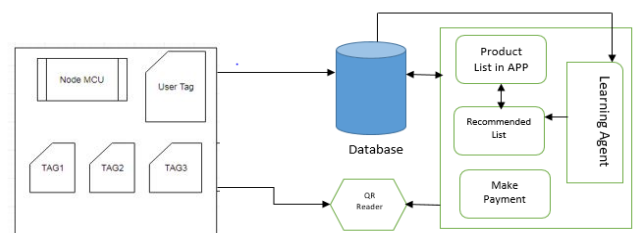


Fig. V.5. Architecture Diagram

In this type of system, all sell items are connected with modern RFID tag. Whenever we enter to shopping mall, we have to read that trolley using RFID. Items which are kept inside a smart and secure shopping cart, with smart RFID retrieving capability can also be automatically retrieved and the bill amount can also be produced in that LCD of the smart IoT using trolley. Smart shopping shelves which are also upgraded with modern RFID scanners can be able to check and verify all stocks, send product status about any update to the main server. It becomes very appealing for modern store, to perform item management for all of the items can also be automatically scanned and very easy to log in. After that, our team attach one QR Reader at trolley. Then directly we can do mobile payment using that QR reader. From admin they can manage all sold out items from through web application. If stock is sold out, easily admin can intimate to Managing directories.

VI. SECURITY SYSTEM MODEL

To make our security display useful, we don't expect the presence of a safe channel. The interchanges ought to be impervious to any spy who effectively screens the available traffic. The security-system of the framework depends on, the trouble of unravelling the MECDLP, that of which is impossible in an attainable measure of time. We broke down the security of the correspondence between the modern smart-trolley and the network-server. The correspondence is between the checking-out point and the network-server are almost the equivalent.

A. Integrity of System

In our development, message which is sent from savvy smart secure cart to the network-server is marked with a shrewd truck's keys, hence trustworthiness is ensured. At the point when the server communicates something specific back to brilliant smart trolley, it makes MAC id utilizing the mystery imparted to the keen cart, and none outsider foe can alter the message while passing check of id MAC. Subsequently, information trustworthiness is all around secured.

B. Confidentiality of System

In every correspondence between brilliant shopping trolley and the network-server, the message sent from the keen cart to the network-server is encoded utilizing shrewd truck's open key. Main security depends on MECDLP, which is also known to and computationally infeasible to crack. The information sent back to the shrewd trolley is encoded utilizing a session-key, is just known to the provide and facilitate customer. Accordingly, no outsider or enemy can make sense of the information in the interchanges. This additionally demonstrates the security in the savvy shopping framework is very much ensured.

C. One-Time Key Model

Each and every time a shrewd trolley demands data from and out of the network-server, it arbitrarily makes a couple of available-session scratches and sends them to the server. The network-server utilizes one of available encrypted key to scramble information and all the other to make a MAC id. The different session keys are created for every

solicitation and, are inconsequential to the past keys. By receiving the session, the information sent from available server to the savvy trucks is all around secured.

D. Tag Security

In view of our plan, the security of all available RFID tags is all around ensured. In the first place, physically pulverizing the RFID-tags or obstructing the modern RFID motion from a RFID-tag can be identified by all the scales on the brilliant smart cart. A little camera can likewise be introduced on the keen cart to collaborate with the scale for the capacity: if the shrewd cart neglects to peruse a RFID-tag and a ruler or camera identifies that another thing is put into the cart, it will send a caution. Secondly, any change to the RFID tags will be identified by checking that MHMAC, which, can't be duplicated by any outsider or enemy without the private key. At long last, exchanging the tags on various things does not work since stripping off the carefully drawn tag can break it.

E. Replay-Attack Resistance Model

In the proposed framework, every correspondence message incorporates a definite period stamp S , therefore making it difficult for any assailant to play out a replay assault. On the off chance that a malignant client replay gives a notification from network-server that consists a thing's value lower than recent value, the keen trolley can recognize that the notification is replayed promptly, checking time value if S in the notification of data isn't predictable with the framework time displayed, the notification will also be disposed of. On the off chance that a malignant client might want to pass the confirmation of the server, he should almost certainly change all the estimation for the occasion's data S incorporated into that figure content, which is absurd. Subsequently, replay assaults are also not useful.

F. Use of 256-bit Encryption Algorithm

In our proposed model, we are using the latest 256-bit encryption algorithm to secure our payment procedure with the dummy bank account. 256-bit encryption means that any hacker or intruder have to try 2^{256} codes to try to crack the encrypted bank transaction details. It is the latest encryption algorithm used in recent technologies and security protocols including the protocols of SSL and AES.

VII. EXPERIMENTAL RESULT

The proposal finally resulted in a good outcome wherever RFID technology replaced barcode wherever barcode is used, it need eyesight and should be placed in its actual boundary whereas scanning RFID do not need any additional requirements. RFID tags are additionally sturdier than the barcode that gets damaged this ensures the method of scanning simple and precise. Then the countersign authentication method aids in avoiding the banned usage of good cards and conjointly prevents knowledge sniffing. The door within the trolley car doesn't open till a product is scanned that doesn't permit to put a product within a trolley that is not scanned. The cause of count of merchandise mistreatment IR device placed

within the trolley car aids in protective the theft of the merchandise and disposing of products that are broken accidentally. Removal a product may be done with the button that guarantees client that merchandise may be removed whenever he alters his mind. The merchandise catalogue shows feature and permits the client for simple search of merchandise with no difficulties. The GSM module sends time to time information to the client mobile for flawless intimation regarding his searching activities. The results show that the projected model is okay for enforcing in current searching environments.

VIII. CONCLUSION

In the paper, our team had introduced a secure-smart and modern shopping system using and utilizing the modern RFID methodology. For first-time the ultra-high frequency RFID had been employed to enhance the shopping experience. The security problems are described in the area of the modern secure and smart shopping system. We had described in detailing the designs of a completely new system and had built a model or proto-type for testing the above technology. Our team also designed a secure method of communication network protocol and represented the security analysis and the performance after evaluations. The trial results affirmed that the proposed correspondence convention can essentially give correspondence unwavering quality, and the human recognition and following technique can accurately determine the real zone in all instances of exclusive developments. In future work, adaptively setting the ideal limit ought to be additionally examined. Increasingly intricate human development designs in different situations (counting LOS and NLOS conditions) ought to be tried. We trust that the future shops will get more secured with modern Radio-Frequency-ID innovation and around then, our exploration will be a spearheading one in the improvement of a keen shopping framework. Our further innovative research will be concentrated to improve ebb and flow framework, for instance, by lessening the computational and overhead for the brilliant smart cart size for high proficiency, and improvement of the correspondence productivity which saving security and properties.

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