Formulate an Adaptive Technique to Validate Near Field Communication Technology using Attributed Graph Grammar-AGG tool

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Abstract

Recently, developments in such Near field Communication Technology (NFC) and associated integrated devices have pace out an acceleration the demand of transactions in electronic devices system such wearable readers which have short-power consumption and proficiency in high transferring data. NFC has showed the alternative active key solution to existing smart electronic devices that depend on huge batteries to supply the energy in paying bills though such devices. NFC widely utilized via wireless power transfer, where devices share and connect with each other, to increase the efficiency of transferring data, with high superb properties such as permeability. NFC has emerged as a powerful technology and its apparatus devices. The ongoing of NFC growth could be related to its extensibility and more sustainable. NFC can deliver different shapes at providing software application capabilities to connect with each other. NFCs demonstrates an adaptable method to enhance and offer current elements accessible to applications across the Internet. NFCs are a new fad and modern technology that shares embedded and ubiquitous devices with others, various corporations are finding the advantage by the NFC. This research will propose a formulation technique to explore and adapt an approach of developing and validating the NFC which permits to exchange data via technology wireless (NFC) between the parties. This technique will facilitate the feasibility of having e.g., a system to reduce of losing duration time and cost for users, as well as, an agile technique for validating the suggested approach via Attributed Graph Grammar (AGG) tools.

Keywords: NFC, Mobile payment system (MPS), AGG tool

1. INTRODUCTION

Advent of NFC and its heterogeneous components has become an important active key in most modern technology. With highly sophisticated and complex systems, users who make using such system could generate more beneficial and high level of outcomes easily. the worldwide is changing a pace towards decreasing utilizing a cash money in most life e.g., in society,

marketing, etc., and focusing on actual social mobility and commercial service evolution years ahead. More, NFC defined as a method that lets utilizing and showing an exchanging data about 10 cm between participants, and that commonly acts at frequency of 13.56 MHz, ergo the transmits data at 474 kb per second. the NFC is a set of collection of measures for hi-tech devices e.g., smartphones, Tablet etc., to introducing radio interconnecting by putting them close to each other. NFC, as a smart equipment can assist to perform purchases through smartphones. [1,13,15,16,17,18]

NFC is rooted in radio-frequency identification technology such RFID which allows compatible hardware to both supply power to and communicate with an otherwise unpowered and passive electronic tag using radio waves. This is used for identification, authentication and tracking.[8,9,13,14,19,20].

Additionally, NFC is a relatively has enormous potential in a variety of applications, including payment, ticketing, gaming, crowdsourcing, voting, and navigation. The near-field communication (NFC) technology permits a set of the integration of active services from a diverse set of applications onto a single smartphone. Due to the novelty of NFC technology, academic data is scarce at the moment, despite the fact that the sum of academic research studies conducted in the last two years has previously exceeded the total number of prior works combined. [8,9,12,13,14,17,21]

Also, NFC technology is short-range wireless RFID that makes use of electromagnetic radio fields to establish cooperative connections rather than the conventional direct radio transmissions, which are now managed by technologies e.g., Bluetooth. On the other hand, mobile payment techniques began in a few countries, including Japan and Canada, before spreading to the rest of the world, including the United Kingdom, the United States, the United Arab Emirates, and lately, in most great countries such, KSA and Qatar. [1,15,25].
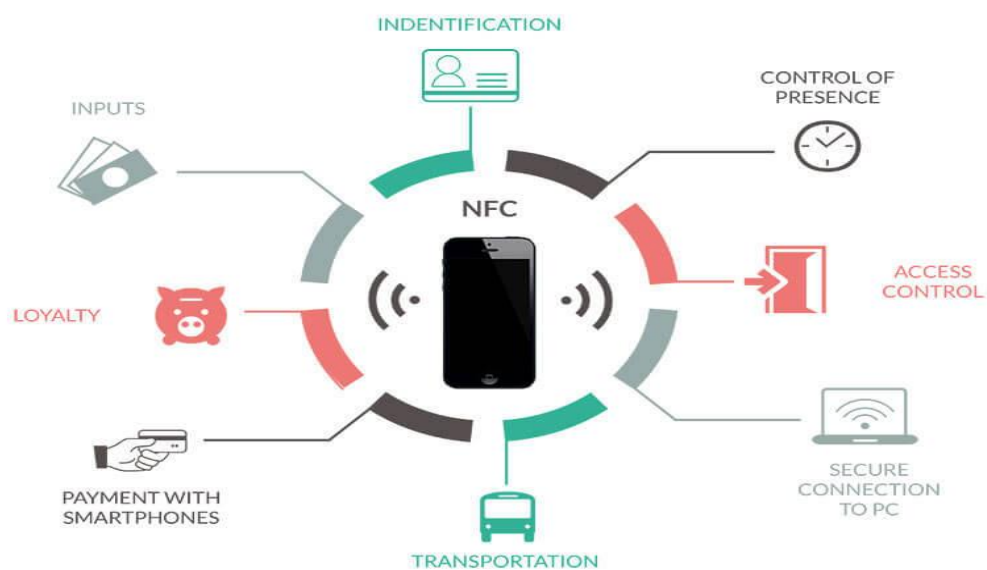

Figure 1. NFC wireless framework connections [1]

2. RELATED WORKS

Initially, most great corporations over cross the worldwide have begun launching a campaign of start using smartphones performing services, in the USA such as Google, Apple and Nokia and other e.g., Samsung. Still, NFC is defined as a process that mandates two active advanced devices with chips deliver small pieces of datasets between each other when they are roughly 1cm-to-4cm through short-range wireless interconnection and at low speeds about 106-414 kbps, depend on system's configurations [6,19,22,23,24,25].

Nokia, Sony and NXP Semiconductors, are among the companies that formed and launched the NFC Forum. The International Organization for Standardization has acknowledged NFC as an active standard model (ISO). NFC is a collection of criteria developed by a consortium on top of ISO principles to certify maximum interoperability throughout all NFC implementations. [6,15,25,26,27,28].

Further, In Japan, the Coca-Cola Company introduced the obtaining a drinks e.g. cans via a vending device using phone device in 2003; this technology has long been accessible in the country, enabling buyers to purchase things through letting their device over a reader at the sale's point. [1,5,14,21,22,23,24].

Moreover, MasterCard announced and launched MasterPass in Canada in April 2013. This initiative demonstrates and delivers a prospective digital service payment facility, with Canadian consumers becoming the first in the world to register their MasterPass services. Because of its ease and security, the MasterPass provides and generates value for consumers and businesses. It has a number of benefits, including providing a seamless, trustworthy, secure, and quick check out regardless of where buyers are or what screen they are using. It has great integrity and preserves credit card and shipping information in a dependable cloud hosted by a reputable business. [1,2,4,24,25,27,28].

In addition, several buying methods are employed by others, viz. using to pay cash, debit, or credit cards, and increasingly, mobile phone purchases. buyers can utilize the mobile web payment technique to pay by entering their information while making a payment. For example, if a merchant creates a payment mechanism that remembers buyers automatically and securely, card information can be recalled and recovered for future purchases. Converting credit card payments into a single click-to-buy transaction increases conversion rates for subsequent transactions. [1,14]. So, in this paper we will provide comperhisive soluation to ease the feasibility of appling such a system to reduce of losing duration time and cost for users, and proving the suggested approach via the Attributed Graph Grammar (AGG) tool.

3. ORIGINALITY

NFC communicates with its associated parties via electromagnetic radio fields, whereas recent technologies, e.g., Bluetooth and Wi-Fi, focus and assist radio transmissions. So, this research demonstrates ensuring that NFC technology is achievable and feasible in an open system environment, thereby

reducing staff and customer time and effort. As a result, the following achievements will be made:

- Proposing and devising an approach that makes using of a mobile payment system (MPS) which operates via near-field communication (NFC) technology to simplify and facilitate customer services in a variety of locations, e.g., tickets for car parking, cinema, and petrol stations.
- Address and investigate the MPS build by retaining critical levels of freedom in a set of structures and giving some aspects in dynamically changing environments.
- Customize and resolve the majority of matters by analyzing MPS to validate and confirm the suggested approach by AGG tool for obtaining an optimal solution.
- Design and examine a prototype structure for NFC technology that will using to tackle system criteria, using a systematic technique that will permit depend on model principles.

Figure 2. Structure of an NFC payment process

As indicated above in Figure 2, NFC enables buyers to pay for utility services and commodities by tapping or passing their mobile devices over another NFC-enabled device, such as a register or terminal. And funds should be sent from the buyer's account whether debit or credit card by the smartphone's wallet, e.g., iPhones, Samsung. [6,8,21,22,25]

Furthermore, the SIM chip card is NFC capable, allowing your phone to serve as a credit card. MPSs have grown more concerned than standard credit cards as a result of NFC technology. It is an appealing market for new entrants because it may be used with a credit card, a smartphone, or a wristband to pay for services for many aspects e.g., tickets for parking, cinema, cafes, and petrol stations. [6,7,25,28]

The following sections comprise the paper: Part I introduces an overview and related work of NFC has shown in Part 2. Discusses the issues and contributions in Part 3. The MPS system design was stated in Part 4. Part 5 contains the Discussion and experiment. Part 6 showed system

implementation and discussed the MPS's critical evaluation and validation by AGG tool. Finally, a concluding remark is made in Part 7.

4. SYSTEM DESIGN

NFC is a collection of contactless communication technologies for use with smart devices such as smartphones, touch screens, and tablets. Contactless communication enables a user to wave and pass their smartphone over an NFC-compatible device to transmit data without physically touching the devices [6,8,15,26,27,28]. In addition, a suggested MPS architecture was employed to handle and enhance the connection and simplicity of NFC technology, hence increasing productivity and simplifying the processing of client purchase transactions.

Figure 3 depicts the MPS's system design diagram, which facilitates some parts to be used to manage the system's streaming data flow.
MPS is feasible in the majority of modern technology that is based on wireless technology.
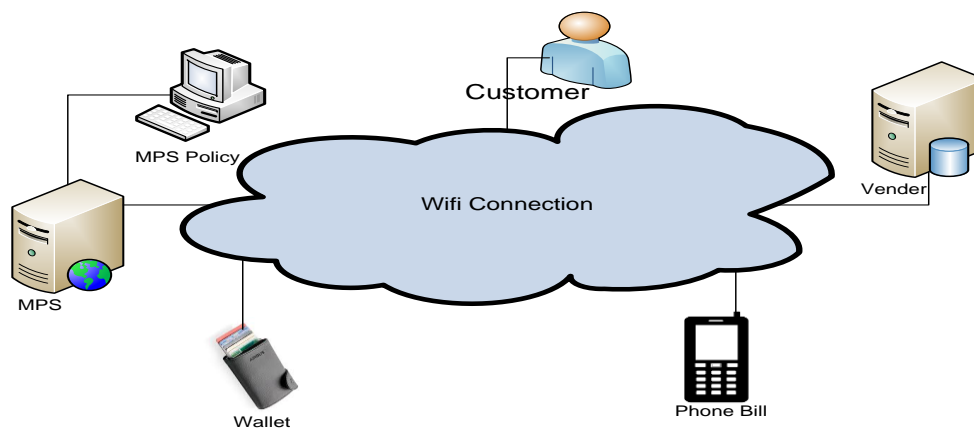
Figure 3. States System design / Structure of MPS

The WIFI network enhances the connection and results. The suggested system design diagram illustrates the sources and methods that occur within the system, as well as the outputs. The vendor and consumers are the sources in this system, letting them to access the MPS software and perform the activities available to them. Yet, the suggested architecture contains some entities to govern data flow, such as the MPS, the vendor, the consumer, the wallet, the phone bill, and the MPS policy.

5. EXPERMENT AND ANALYSIS

The use case diagram has been used to illustrate MPS procedures, and numerous businesses have used case diagrams to design such a system in order to ensure its practicality and flexibility. The primary benefit is that it mentions at describing the scope of the strategy. In addition, the model is created using the Unified Modeling Language (UML). The UML [2,4] enables

dynamic depiction of the system's design using diagrams. [6]. The MPS use case is critical in demonstrating the requirement technique that has been proved a critical feature of the system's process. The MPS use case, on the other hand, is a series of steps that specify the interactions between critical roles inside the system in order to accomplish a goal.

As illustrated in Figure 4, the use case specifies the sequences of activities that a system, subsystem, or class can execute when engaging with external actors.
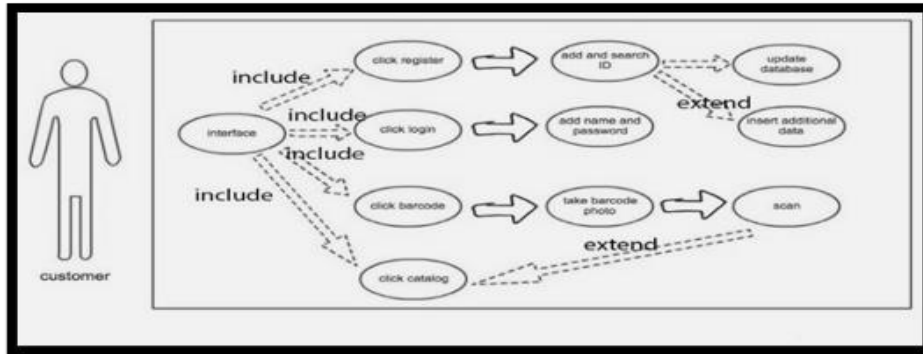

Figure 4. Use case of building MPS

In this use example, we have a single actor called a customer, and the main menu will serve as the interface. This use case is comprised by four other use cases: registration, login, barcode scanning, and catalog. Moreover, when a new client enters the interface and clicks register, the customer's ID is added and then searched for within the program. Also, the database's data will be updated automatically. After completing the registration process, the customer should access via the login button to insert their authentications i.e., a name and password. The third criterion is that when the consumer clicks the barcode button and snaps a photo of the product they wish to purchase, the program scans it and the customer transitions from barcode to catalog to select the product.

Figure 5. Dataset of structure dictionary

To begin, an analysis of the system of items with which users should interact is conducted in order to categorise each thing and its relationship to other objects. This method results in a picture of object association components as a result of data modeling and leads. Each data object is given a descriptive name, its relationship is documented, and the type of data is identified, such as text, image, or binary value. Predefined values are stored, along with a brief textual explanation.

This group can be compiled into a book dubbed a data dictionary for reference purposes [2,5,21,22,24,25]. The Data Dictionary, also known as the data bank repository, is a collection of names, definitions, properties, and aspects pertaining to data descriptions that are used or collected in a database or information system [6].

When planning and developing software that makes use of the data model, it is recommended to reference the bank of data dictionaries. To understand how a data item should fit into the structure, what values it may have, and what it signifies in real-world circumstances. [2,5,24,25,26].

JDBC stands for Java Database Connectivity which illustrates a datasets relationship and is simple to operate with the MySQL database engine. We developed and executed the SR barcode program using MS-Sun Java, a computer high object-oriented programming language that acts as an NFC technology, allowing developers to create and utilize it on both the client and server sides, allowing it to run as a distributed system everywhere.

During any transaction, the database is used to store the dataset. Furthermore, this database is critical and should be developed in accordance with the system requirements. These requirements specify the state of the database and the types of relationships between its tables. [7,25]

Figure 6. States program interface

The SR barcode program utilizes a smartphone to manage and enable purchases from any store, including malls, restaurants, and gas stations. The SR barcode is compatible with barcode scanners, payment processing systems, and mobile devices such as smartphones. It's simple to read information and "snap up" special deals, promotions, and discounts from intelligent posters or intelligent billboards. Buyers with an active smartphone can scan the picture of the SR code with a camera and an appropriate scanning program, which

makes activation the data stored, providing a quick and effective means for to acquire information about the product in a whole new way.

Nevertheless, while the majority of vCards have major contact information fields such as phone numbers, addresses, email addresses, and Internet URLs, they are not limited to those. The standard has been amended over the years to incorporate new fields and data types. vCards contain critical directory information such as name pronunciation, and the majority of vCards include elements like as images and multimedia, pictures, company logos, and audio clips for name pronunciation. Geographic and time zone information in vCards enables others to reach you at the most convenient moment. Also, vCards support a variety of languages, including English. the vCard is agnostic of transport and operating system, which can run vCard-ready software on any platform device. [1,2]

Figure 7. States adding the program information

As illustrated in Figure 6,7,8, 9 and 10 respectively, any new client or buyer needs to register then login with this program in order to use it. It requires creating a user ID, name, address, and city, among other things, and each user needs to insert their information in order accessing the program's system. Nevertheless, because the user id and password are required to access the program's system, each figure indicated and demonstrated its function.

Figure 8. States accessing to the program system

Yet, in order to encrypt all information on debit/credit cards using an algorithm, the program system involves an effective payment system via active smartphone, i.e., the iPhone's wallet app.

Figure 9. States inserting cards information

Figure 10. States access and login to the program

5.1 ASSESSMENT AND PROOF OF THE MPS BY AGG TOOL

Graph grammars are used as a specification technique for a subset of specific types of systems, particularly when states exist as a set of complicated structures that should be effectively modelled as graphs and the behavior is highly parallel. They can be thought of as responses to stimuli that are visible in the system's state. Graph grammars are a type of a structure formal language that is adequate for the computational systems.

AGG is a collection of progress environment for algebraically supported transformation of attributed graph systems. Its objectives are to facilitate and specify the development of complex graph-structured data applications. The AGG environment is constructed as a mix of collection of methods for completely controlling, changing, and defining typed and attributed graphs. By possessing and adopting an AGG graph grammar, it is possible to validate it through the use of ability analysis techniques. [4,7,11].

More, The MPS's proposal technique has addressed and tamed the majority of issues and produced an adequate result that is reusable in related contexts. The primary benefit of this adequate technique is that it demonstrates the viability of the suggested approach over the open environment by investigating it using AGG tool. The results then demonstrate the ability to achieve eligible flexibility in order to advance the MPS system performance in different environments by utilizing existing resources and activities.
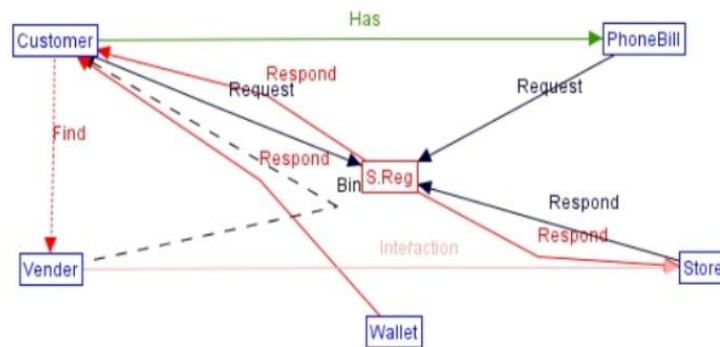
Figure 11. States the MPS diagram designed by AGG tool to prove the suggested approach.

As appeared in Figure 11, the primary key role of AGG is to maintain pure visibility, thereby facilitating the MPS's suggested approach by trapping with the progress toward typical solutions. The AGG language is a rule-based visual programming language that tackles the graphing and representation of transformations through an algebraic approach. It is a collection of applications organized into a simple design that classifies the pace of the entire model. It assists developers and designers in visualizing the model in a way that is feasible and defines each stage of the approach. Thus, we review these nodes by analyzing high possibilities of achieving the desired outcomes using test techniques in order to obtain the best results possible. As a result, these assessments should state the model's validation and the possibility of practical applicability through the use of standard results. [3,4]

Additionally, as illustrated in Figure 10, the model scenario demonstrates that all of these components registered and interacted with each other in accordance with MPS's policy requirements. Thus, the customer, the vendor, the phone bill, and the wallet are all black-box services that work in tandem to advance progress and connectivity.

5.2 THE ALGORITHM METHOD FOR THE MPS APPROACH

Pseudo code is a mix collection of pure descriptions of a computer programming algorithm in the form of a collection of processes, as depicted on Figure 12. As stated in algorithm method, it demonstrates and shows how services can be registered as venders/ buyers based on MPS's policy. This algorithm has demonstrated the feasibility of investigative the primary approach of the suggested technique and its impact on the MPS system in a compact manner. [4,7]

In addition, the algorithm commonly eliminates details that are not necessary for comprehension, which including variable declarations. The benefit of utilizing pseudo code over traditional programming language code is that it is more easily understandable. Additionally, it is the process of outlining the program's structure prior to actually writing the code.[4,7] This

algorithm has declared the flexibility to perform this SR barcode program to achieve the NFC capability of system.

```
1.  Variables = counter,Interact_of_services[A],
    List_of_services[L],Return_of_services[R],Report[P]
2.  Begin()
3.  Do:
4.  For all services ∈ All_Services All_Services ← getAll_Services
5.  Counter ← getServices_no(i) List_of_services[L] ← All_services
6.     For i=0; i<counter;
7.     i++
8.     Read(List_of_Services[L])
9.     End for
10.
11. Interact_of_services[A] ← getAll_Services
12. For i=0; i<counter;
13.    i++
14.    getRotate Interact_of_services[A] Read(Interact_of_services[A])
15.    If a vender unregistered with MPS(), then, register it as
       s.provider() to the list of venders. Otherwise, adding it to
       list of venders.
16.    If a customer unregistered with MPS(), then, register it as
       s.client() to the list of customers. Otherwise, adding it to
       list of customers.
17.    If found interaction between any services ∈  All_services, then
       Insert Interact_of_services[A] into Return_of_services[R]
18.
19.     else if no interaction found with ∈ All_services == ∞
20. End For
```

Figure 12. Algorithm for MPS Approach

6. CONCLUSION

Nowadays, NFC has developed into a dynamic service that continues to mature as a result of the technological revolution. Numerous players in the telecom industry, such as Google, Nokia, Samsung, Apple and others, can have and adopt NFC technology. We are in the midst of a mobile smartphone wallet era in which cash value can be stored on a card, phone, or other electronic device that can be topped up. Wallet is a term that refers to a debit or credit card that is embedded in a phone, rather than carrying pocket money.

Consequently, this should enable and grant smartphone consumers worldwide the ability to pay for a wide variety of activities via their handsets, including services, digital content, and physical goods.

Nonetheless, technologies viz., Wi-Fi and Bluetooth resemble NFC in that they facilitate exchanging data and wireless communication between digital devices i.e., smartphones. NFC works by utilizing a mix of electromagnetic radio fields, whereas Wi-Fi and Bluetooth rely on radio transmissions. With NFC, the capability of automatically connecting and launching with another NFC machine enters the four-inch range. Thus, this research paper set up and developed a technique for exchanging wireless data between parties within an open system environment using technology.

Developing such a system is time consuming, and it may involve a variety of factors that necessitate exploring the MPS plan by giving some elements in dynamic environments.

As a result, we implemented the SR barcode program, which can be used in conjunction with NFC technology in a variety of locations, and then adapted it to manage the structure of requirements, thereby establishing a systematic process that the model criteria can leverage. Then, using AGG tool, proving and validating the suggested approach to achieving the proper solution.

Furthermore, the NFC technology enables a diverse wide range of studies and investigations. NFC technology can be used in a variety of applications, including transportation, new smart cities, higher education, and the health sector. Developing and using such a system design should be facilitating the way of paying bills which can reduce the time and cost. Also, this research is ongoing, it should have further study in order to analyze some features of this work to discover and obtain the capability of these fields. Several extensions to the NCF technology can be made.

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