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Advanced IMEI and Credit Card Validation Techniques using Layered based LUHN's Algorithm

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***Abstract*—**Electronic cards are trending in the present scenario for carrying out secure and cashless transactions.There is a need to understand different sources of threat which can result in inappropriate use of Electronic cards by using forge Access Credentials.One can easily store all the relevant details of cards just by Swiping them into a Point of Sales(POS) transaction device,later the details of the card such as CVV and four digit pin can be stored into the buffer which can be used to create a Similar Credit Card and Withdraw as much money as possible.Similarly IMEI is a Key Parameter of Every Electronic gadget to be specific to Mobile Phones,the primary purpose of IMEI is to uniquely identify each and every mobile phones.

The present paper attempts to define a method which can be used to validate a given IMEI number on whether if it is valid or not,the same method can be used to validate most of the Credit Card and Debit Cards as well,this will result in a secure mean in dealing with mobile phones as well as secure plastic card for digital transactions based its authenticity.

Keywords:*IMEI Classification, Odd and Even Layers,Type Allocation Code(TAC),Luhn's Algorithm,Modular Division, Checksum Method,Alphanumeric Validation.*

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I. INTRODUCTION

This is an Era of Digitization where the physical presence is not mandatory to carry out any transactions, digitization is essential to raise the progress and growth level of any economy at the same time it is important to understand that digitization will also lead to deceit and treachery activities which can be prevented a set of well-defined techniques to keep a check on authenticity of every transaction at any given instance of time[15]..This will bring about building trust among people who hesitate to perform online transactions fearing of falling victim of cheat[5].Digital Transactions have digital means on whom they are performed,this digital medium most of the time deals with numeric attributes which is about 15 digits in length and contain some hidden part of hierarchy based information providing to the root of details on every transactions,some of the examples of such Numeric Attributes are IMEI numbers,Credit Card Numbers,One Type Password(OTP),Card Verification Value(CVV)[11].

In order to perform secure transaction worth volumes of rupees and assets it is very important to validate them at every stage to find whether they are genuine or not. For Every transaction there must be some means of Mechanism to validate that the transaction is valid or not[5].

II. RELATED WORK:

Validation is an important aspect of any operation, this enables any task to protect against deceit and treachery,Validation of transaction very important to inspect whether a particular product is a Genuine or not. There are mechanisms to validate different entity for different entity.Validating Credit cards is absolutely necessary to guide ourselves from being cheated while in any point of time.There are different methods to validate credit card,the most simple and elegant is one which does not require any electronic gadget owned privately or available publicly.Similarly Validating IMEI Numbers is very essential to determine whether a particular mobile phone being purchased is an original one or a morphed one.in validating an IMEI Number we need special access to IMEI Repository which is owned by Private vendors, A Simple Mechanism should be used to determine a valid IMEI Number in a fraction of a second. In Validating an IMEI we need not require any Special access to such IMEI Repository as this might not available in all the Situations and n all the circumstances. A Mechanism must be provided which can assist to validate Credit card, IMEI and Such Numeric Identifiers in a simpler manner, Some Approach may yield result only under certain circumstances, We need much Strong Approach which can Validate both entities and also must be very simpler in nature.

III. EVALUATION OF IMEI AND CREDIT/DEBIT CARDS.

Let us understand the anatomy of IMEI Numbers,how are they formulated,the different set of hidden information they

carry of for each Mobile Phone. IMEI(International Mobile Equipment Identity) is a unique code assigned to each mobile phone during its manufacturing,it consists of 15 digit code that has a series of segments,each of this segment has a special meaning to be identified for brand,country of origin and seller identification.All this attributes assists in overall formation of IMEI Code.

	AA BB BB BB		CC CC CC	D/EE
IMEI	TAC	FAC	Serial no.	Luhn Check
IMEISV	TAC		Serial no.	SVN

Table 3.1 IMEI Structure

The overall IMEI Number is Composed of 15 digits, It has 3 segments of code they are as follows:
1.Six digit TAC
2.Two digit FAC
3.Six Digit SNR.

These 3 segment of code will form into overall IMEI Number for any Given Mobile Number.The Purpose of each of the above mentioned is described as follows.

TAC[Type Allocation Code]:A TAC code is a unique 8 digit identifier which is used to uniquely identify a wireless device,it can be then used to identify hard ware details on a particular wireless device,this forms as an integral part of IMEI code which is prefixed with TAC code.the first two digit of TAC are used to reporting body identifier which defines GSMA approved standard for given model device and is allocated with a unique code[11].

TAC	Manufacturer	Model	Internal Model Id
35881905	Apple	iPhone 5C	A1456
35881605	Apple	iPhone 5C	A1456
35881505	Apple	iPhone 5C	A1456

Fig 3.2 TAC Database.

As shown above,the TAC code comprises the first 8 digit of digit IMEI Number as follows, the overall 15 digit IMEI number describes a number of details such as operator code,supplier name,manufacturer ID etc.

IMEI	TAC
358819050136485	35881905
358816050138403	35881605
358815050134543	35881505

Table 3.3 TAC Position in IMEI

FAC[Final Assembly Code]: It is a manufacturer-specific code indicating the location of the device's construction,prior it used to begin with 0 with all apple mobile phones,FAC describes unique Manufacture identification internal to a production of a mobile phones in the company,FAC contains very little information about the specification and other details of the device,rather Code is being used to manufacturer details of the device[7].

IMEI	FAC
358819050136485	01
358816050138403	01
358815050134543	01

Table 3.4 FAC Database

SNR[Serial Number]: It is the reminder 6 digit code which will contain device based serial number to be identified across the world by the specific Mobile producer.this provides an essential means to pull all the details of the device upon request to the company,serial number describes the following information:
1.Name of the Brand
2.Manufacturer id.
3.Export id.
4.origin country code.

All this information is sufficient to track the details of the device once it is issued by the Mobile company,Now the device can freely move to any country and Any place as its core details are with the producer of the company. All the Above details are put together to form an overall IMEI number which can be used to identify each and every mobile and other wireless gadgets to keep its core manufacturer intact[3].

IV. AUTHENTICITY OF CREDIT CARDS AND IMEI NUMBERS:

As we have understood the core classification of IMEI numbers with reference to each and every code and its purpose in IMEI,a similar classification exists for Credit card numbers as well,the problem we need address is to how do we know whether a particular IMEI or Credit Card is valid or not.it is very important to ascertain the authenticity of IMEI Credit Card which will result in huge

transaction loss eventually will lead to fraud and illegal activities[6].

IMEI Number Validation is very important to protect against probable security flaws which might result in terror activity with mobile as one of the prime source to be used as a mode of connectivity.similarly validating a credit card is also a very important aspect in overall secure authenticated transaction process,there are a number of different ways in order to Validate a credit card or an IMEI number,the most convenient among them is Luhn's algorithm[6].

4.1 EVALUATION OF IMEI AND CREDIT CARD NUMBERS USING LUHN'S ALGORITHM:

The Luhn's algorithm also known as "modulus 10" or "mod 10" algorithm, is a simple checksum formula used to validate a variety of identification numbers including credit card numbers, IMEI numbers.It was created by IBM scientist Hans Peter Luhn's and described in U.S. Patent No. 2,950,048, filed on January 6, 1954, and granted on August 23, 1960[5].

The algorithm is Very popular in validating a Credit card but it can also be applied to various other important Numeric identifiers,its a simple mod by 10 division which describes on whether a particular code is valid or invalid based on the result of the mod operations with position based value parameters,it simply adds certain numbers at their specific numbers at their base positions and performs a MOD operation,if the result of the Mod operation is Zero the resultant number IMEI or Credit Card number is valid else it is invalid,the same method can also be applied to National Provider Identifier numbers in the United States, Canadian Social Insurance Numbers, Israel ID Numbers and Greek Social Security Numbers (AMKA).The outcome of the Luhn's algorithm is a valid or invalid number based on its result from the modulus division operation[14].

Luhn's algorithm is typically used for authentication of numbers of different means,in our implementation of Luhn's algorithm we will use it to validate whether a given IMEI number is valid or not.This method can be randomly applied to any IMEI device instantly to find the result,rather them having look up to a particular GSMA database in order for the presence of IMEI code[8].

Let us apply the above algorithm for a Sample IMEI Number to Check Whether its valid or not

On Application of the Above Method, We can Find Whether a given IMEI or Credit Number is valid or Not using LUHN'S Algorithm, this is the simplest Approach Which can be used for Most of the Numeric based identifiers whether on valid or not.

Algorithm: CreditCard_IMEI_LUHN
Step 01: Start
Step02: Read IMEI or IMEI Number 'N'
Step 03: Assign position Values for each Number as:
For Each Number Starting from Zero,
Assign 1 for all Even Numbers
Assign 2 For All Odd Numbers
Step 04: Take the Sum of all Even Numbers
Step05: For Each Odd Number Multiply with its Basevalue*2.
Step06:if Result of each Odd Number multiply by 2 is greater than 9, Add to individual bits and Sum Them.
Step 07: Compute the sum of Both Even & Odd Numbers After Step 04 & Step 05.
Step 08: Perform Mod Operation on Sum by 10 i..e Sum%10.
Step 09: If the Result is Zero, then the Given IMEI is a valid Number.
Step 10: If the Result is a Non Zero Number the result is Invalid.

Fig 4.1: IMEI_Credit_Card

Consider the example of an IMEI number "862563036631210".

Step 1 – Starting from the rightmost digit double the value of every second digit,

8	6	2	5	6	3	0	3	6	6	3	1	2	1	0
1	2	1	2	1	2	1	2	1	2	1	2	1	2	1

Fig 4.1.2 IMEI with Base Points

Step 2 – If doubling of a number results in a two digits number i.e greater than 9(e.g., 6 × 2 = 12), then add the digits of the product (e.g., 12: 1 + 2 = 3, 15: 1 + 5 = 6), to get a single digit number.

8	6	2	5	6	3	0	3	6	6	3	1	2	1	0
1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
	12		10					12						

Fig 4.1.3 IMEI with Base Points(odd and Even)

12:1+2=3

Step 3 – Now take the sum of all the digits.

8+3+2+1+6+6+0+6+6+3+3+2+2+2+0

=50

Step 4 – If the total modulo 10 is equal to 0 (if the total ends in zero) then the number is valid according to the Luhn formula; else it is not valid.

Since the sum is 50 which is a multiple of 10, therefore the IMEI is valid.

Ex02:Validating a Credit Card,Lets us Validate a credit card with a sample credit card number as follows:

Consider the an Credit Card number "862563036631".

Step 1 – Starting from the rightmost digit double the value of every second digit,

5	5	4	2	1	3	5	6	1	1	4	1	2	5	0	1
1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2

Fig 4.1.4:Credit Card with Base Points

Step 2 – If doubling of a number results in a two digits number i.e greater than 9(e.g., 6 × 2 = 12), then add the digits of the product (e.g., 12: 1 + 2 = 3, 15: 1 + 5 = 6), to get a single digit number.

5	5	4	2	1	3	5	6	1	1	4	1	2	5	0	1
1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
10						12							10		

Fig 4.1.5:Credit Card with Base Points(Even and Odd)

Step 3 – Now take the sum of all the digits.

5+1+4+4+1+6+5+3+1+2+4+2+2+1+0+2

=43.

Step 4 – If the total modulo 10 is equal to 0 (if the total ends in zero) then the number is valid according to the Luhn formula; else it is not valid.

Since the sum is 43 which is a not multiple of 10, therefore the remainder is 3 after MOD%10.

4.2 VALIDATION OF IMEI AND CREDIT CARD NUMBERS USING CHECKSUM BASED ENHANCED LUHN'S ALGORITHM:

As we learned on how to validate an IMEI or credit card number using LUHN Algorithm,we can enhance the same method in validating Credit Card numbers to make it more secure,we can Embed a checksum code within Credit card Numbers which will strengthen the Applicability on validation of Credit card well defined Secured manner[11].

This process is more efficient where in a given checksum is embedded at the last digit or the last digit of the Credit card acts as a Checksum In order to validate Credit Card Number,this method is much enhanced version of the previous[11].

Algorithm:CheckSum_CreditCard__LUHN

Step 01: Start

Step02: Read Credit card 'N'

Step 03: Assign position Values for each Number except the last digit as:
For Each Number Starting from Zero,
Assign 2 for all Even Numbers
Assign 1 For All Odd Numbers

Step 04: Take the Sum of all Even Numbers

Step05: For Each Odd Number Multiply with its Base value*2.

Step06:if Result of each Odd Number multiply by 2 is greater than 9, Add to individual bits and Sum Them.

Step 07: Compute the sum of Both Even And Odd Numbers After Step 04 and Step 05.

Step 08:Perform Mod Operation on Sum by 10 i..e Sum%10.

Step 09: If the Result is Non-Zero, subtract the Result with the LSB of the code

Step 10: If the Result after subtraction is 0,then the result is valid

Step 11:If the Result aftersubtraction does not yield a 0 value, the result is not a valid Credit Card Number.

Fig 4.2.1:Check_Sum_Credit_Card

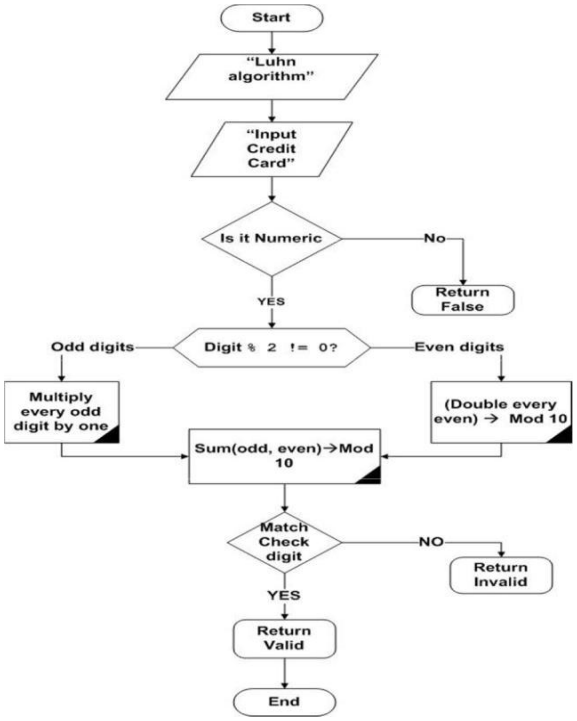

Fig 4.2.2:Control Flow for Check Sum Method

The above fig represents contextual flow of Credit Card Validation using Check sum variant of Luhn's Algorithm,the initial process begins with accepting credit card number as input,the first stage is to validate whether the input is a valid credit card number,if it is a valid number we proceed with a loop which will divide the input

numbers into two categories i..e Even and Odd.Once the input is segmented we now multiply every Odd number by 1 and every even number by 2,we now proceed with Adding up all the Numbers,in this process we igmore the LSB Number of the Credit Card,LSB serves as a Check Sum digit,the Generated sum is Operated with MOD 10.The result of the operation is observed and is subtracted with 10.If the obtained result subtracted with 10 gives a Number Which now Subtracted with the Check Sum Digit.

If the result of the latter subtraction leaves a remainder zero,then the result is a valid credit card. Number,with the result is a non zero number after the latter subtraction the result is Not a Valid credit card Number.This Process is much more fast and effective when compared to the First Method as it enables to Generate a check sum embedded with in the Credit card itself as a LSB,There is no need of any third part tool or special access previlage to check whether a given Credit Card Number is valid or not.

Consider an example on application of Enhanced Checksum Based Luhn's Algorithm using Luhn's algorithm.

Consider the example of an credit card number "4616800000747098".

Step 1 – Starting from the rightmost digit double the value of every second digit **Except Last Digit.**

4	6	1	6	8	0	0	0	0	0	7	4	7	0	9	8
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1

****Last column is the Checksum**

Fig 4.2.3:Credit Card with Base Points Check Sum Method

Step 2 – If doubling of a number results in a two digits number i..e greater than 9(e.g., 6 × 2 = 12), then add the digits of the product (e.g., 12: 1 + 2 = 3, 15: 1 + 5 = 6), to get a single digit number.

4	6	1	6	8	0	0	0	0	0	7	4	7	0	9	8
2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1

16 14 14

Fig 4.2.4:Credit Card with Base Points with Check points(odd and Even)

16:1+6=7

Step 3 – Now take the sum of all the digits.

8+6+2+6+7+0+0+0+0+0+5+4+5+0+9

Sum=52

Step 4– Perform Sum%10 i..e 52%10,the result is 8,Now subtract result-10 i..e 10-2=8.

Since the result is 8 and the Checksum is also 8,therefore the given credit card is valid.

V. CONCLUSION:

Validation techniques are very essential to evaluate a particular entity,IMEI and Credit card validations are very important for Every digital transaction to protect from deceit and fraud,validating without any external toolkit makes it more simple for every person to identify whether a given credit card or IMEI is valid or not,LUHN's algorithm is popular in evaluating various Authentication codes.The proposed methodology is confined to validation of only Numeric codes,an approach can be developed to validate Alphanumeric codes using LUHN'S Algorithm with an Enhanced methodology.This will further extend means for developing a single algorithm to validate any combination of codes using a simple algorithm with fewer number of steps.

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