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Highlights

Analysis & Design of Visualization

New Landscape of Energy Efficiency

Discovering Thoughts, Inventing Future

VOLUME 18 ISSUE 4 VERSION 1.0

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Analysis and Design of Visualization of Educational Institution Database using Power BI Tool

By Mandava Geetha Bhargava, K. Tara Phani Surya Kiran & Duvvada Rajeswara Rao

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Abstract- Visualization of data set is a process of making understand the significance of data through visual context and part of data analytics where it's executed after the data correction. Nowadays visualization is more useful in business intelligence and Analytics in every field, There are different techniques for visualizing the datasets, it may be in dynamic or interactive nature, and datasets can be visualized in different types of visuals insights, This paper deals with the interactive visualization of educational institution database using Microsoft Power BI Tool with different modules and this paper focuses on process model, operations of Microsoft Power BI, types of data sources available in Tool and its different related types of visual insights or context.

Keywords: *analytics, visualization, business intelligence, insights.*

GJCST-C Classification: *I.6.8*

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Analysis and Design of Visualization of Educational Institution Database using Power BI Tool

Mandava Geetha Bhargava [α], K. Tara Phani Surya Kiran [σ] & Duvvada Rajeswara Rao [ρ]

Abstract- **Visualization of data set is a process of making understand the significance of data through visual context and part of data analytics where it's executed after the data correction. Nowadays visualization is more useful in business intelligence and Analytics in every field, There are different techniques for visualizing the datasets, it may be in dynamic or interactive nature, and datasets can be visualized in different types of visuals insights, This paper deals with the interactive visualization of educational institution database using Microsoft Power BI Tool with different modules and this paper focuses on process model, operations of Microsoft Power BI, types of data sources available in Tool and its different related types of visual insights or context.**

Keywords: analytics, visualization, business intelligence, insights.

I. Introduction

Data Visualization is a process of making understand the significance of data through visual context, and it is a part of analytics, there are several techniques to visualize the data such as Interactive and Dynamic in nature and coming to visual context, there are a number of things such as plots, graphs, slicers, stacked column charts, Histogram, Bar Charts, tables, matrix and other forms of visual contexts; In this paper we focussed on interactive data visualization through Microsoft Power BI tool, Microsoft Power BI is a suite of business intelligence and analytics tool for analyze data and share insights and gets answers quickly with the help of interactive data visualization using dashboard available on every device such as Applications, Desktops, Mobiles…etc. With the help of visuals and filters, the user or person gets convenient and easier to understand the data and it has an architecture of five main components as discussed below and follows Power BI Services, Power BI Gateways, Power BI Desktop, Power BI Apps and Power BI Connectors as shown in figure 01. Power BI Services is the main component in the architecture where published reports are made into dashboards to share in the organization, Power BI Gateways is another main component in the architecture where it handles to get data operation from different data sources by means of connectors and protocols, Power BI Desktop is the component in Architecture where the data is analyzed and transformed through some procedure using tools and made to report on the web by means of several visuals, tools and publish feature.

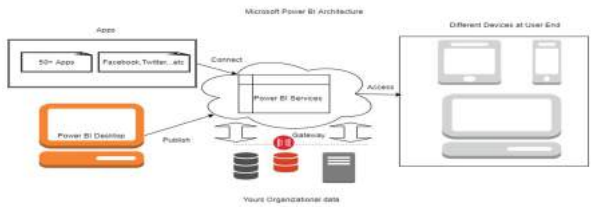

Fig. 1: Architecture of Microsoft Power BI

Power BI Apps are the crucial components at user side where viewing and accessing of dashboard through some applications such as Power Apps, Mobile Power BI...etc., Power BI connectors leads crucial role in getting data from the database and other sources using connector application such as database engines, Azure Consumption Insight Connector…etc. The general operations of Microsoft Power BI are as follows: 1) Get the Data from Required Data Source2) Analyse the data by means of connectors and gateways of organization3) Build the Report by means of Different Visuals and Filters4) Publish the Report into web through Power BI Desktop5) Edit the report if any changes are needed and make shareable by means of publishing on to web option for creating embed URL 6)Access the report data from different applications of Microsoft such as Power Apps, Mobile Power BI 7) Refresh the data using different gateways of Organization for updating the dashboard. In this paper, we discussed on process model and Visuals of the Power BI tool and interactive data visualization technique for analysis and design of educational institution data visualization using Microsoft Power BI tool.

II. Process Model of Power BI

The Process model consists of Seven steps as discussed below and shown in figure 03, GET DATA, FETCH, PROCESS, ANALYZE, VISUALIZE, EDITING, WEB.

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a) *Get Data:* In this step, the end user is going to get data from different sources such as files, databases, Microsoft Azure, Online services and other as shown in details of data sources.

b) *Fetch:* In this step, the data which is selected through browsing data location or using queries by selecting types of data sources and connectors.

c) *Process:* In this step, the data is truncated and edited using several operations while loading the data into the Power BI.

d) *Analyze:* In this step, the data is analyzed using filters, conditional Queries and other operations such as adding colum
erroneous data.

e) *Visualize:* In this step, the analyzed and processed data is visualized through means of visuals such as Microsoft Power BI Visuals and Custom Visuals like plots, graphs, slicer, KPI...Etc. After this process, the report is published to power BI services.

f) *Editing:* In this step, the published report on to web is finalized after rectifying errors for any changes such as if any filters or visuals need to solve and after completion of the editing process, the report is made to publish on the web.

g) *Web:* As said above step, it is a state where the report is converted into the dashboard, and it can be share-able via URLs, websites. Etc.

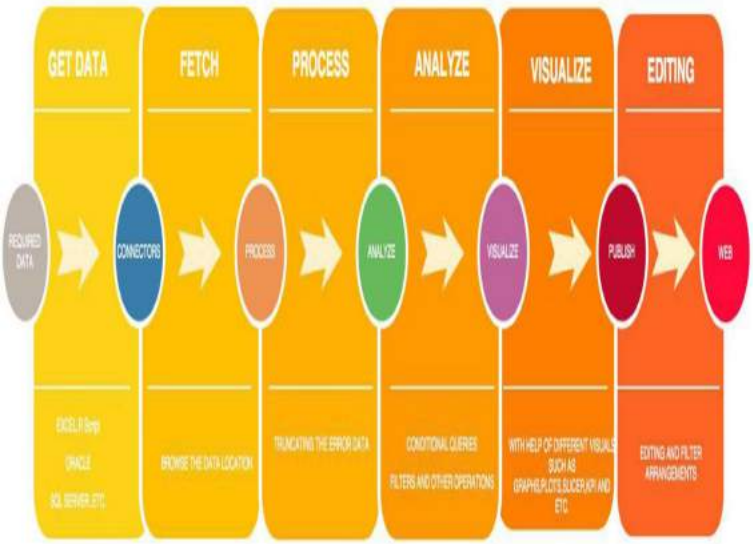

Fig. 2: Process Model of the Power BI Desktop

III. Types of Visuals in Power BI

The Microsoft Power BI visuals provide high-quality visualizations of data that you can use to extend Power BI. Microsoft Power BI contains over 20 different types of visual contexts, the framework to run them, and the testing infrastructure that enables you to build high-quality visuals. The framework provides all the interfaces you need to integrate fully with Power BI's selection, filtering, and other UI experiences. The code is written in Typescript, so it's easier to build and debug. Everything compiles down to JavaScript and runs in modern web browsers. The visuals are made using D3, but you can use your favorite technology like Canvas, SVG, or Web GL. This enables you everything you need to build custom visualizations for Power BI.

There are two types of visuals in power BI. 1) Microsoft Visuals, 2) Custom Visuals.

1) Microsoft Visuals

These are the official visuals from Microsoft, and some were built-in visuals in power BI installation package.

They are secured in nature and following are the official Visuals of Microsoft such as Stacked bar chart, line chart, Waterfall chart, Area Chart, Clustered Bar chart, Slicer, table, and Matrix…etc.

2) Custom Visuals

These visuals contexts are developed by the third party or the end users such as developers and these are shared among the users through the portal like office store and git Hub. They are unsecured in nature and following are the Custom visuals provided by third party and Microsoft officials such as dot plot, route map, flow map, journey chart, and scroller…etc.

IV. Details of Data Sources

Table 1: Details of Data sources

Data Format	Data Sources
Files	Excel, Text/CSV, XML, JSON, Folder, Share Point Folder
Database	SQL SERVER, ACCESS, ORACLE, IBM DB2, IBM INFORMIX, IBM NETEZZA, MySQL, Postgre, Sysbase, Teradata, SAP, Google Bigquery, etc.
Azure	Azure SQL database, Azure SQL Data Warehouse, Azure Blob Storage, Azure Table Storage, Azure HD Insight(HDFS), etc.
Online Services	Power Bi service, Share point online list, Dynamics 365, Microsoft Exchange Online, Salesforce, Google Analytics, Facebook, Github, etc.
Other	Web, SharePoint list, OData Feed, Active Directory, Microsoft Exchange, Hadoop File(HDFS), R Script, ODBC, OLE DB, etc.

V. Literature Reviews

Marija Blagojevic et al.[1] studied on web-based intelligent report of e-learning system by using the technique of data mining and it deals about PDCA method such as (Plan, Do Check, Act) for improving the web-based intelligent reports of eLearning system by means of data mining techniques and concluded that their proposed system has an improvement since it predicts behavior patterns thus leading to the increase in count of participants and in there study ,it proved that their proposed system has improvements in terms of report system in the field of LMS (learning management system) or e-learning . Moreover, the development and implementation of new modules.

*Daniel J.Power [2]*studied the data-driven decision support system and it deals with data-driven decision support system and its advantages at Business Intelligence and concluded that mainframe-based decision support systems would need to be updated or replaced by web-based or web-enabled systems the accessibility reach for data-driven decision support systems are open source software's, new hardware's, web technologies, etc.

Zhijun Ren [3] studied the delivering of a comprehensive Business Intelligence solution using Microsoft Business Intelligence stack and it deals about features and advantages of business intelligence stack of Microsoft and concluded that by integrating several technologies such as database, connectors, SharePoint servers, and business intelligence tools will lead to Faster delivery of comprehensive business intelligence solution within an enterprise

Guangzhi Zheng et al. [4] studied on business intelligence to healthcare informatics Curriculum and their paper deals with the preliminary analysis of integration of Business Intelligence with Healthcare Information Technology and concluded that Business Intelligence had been a neglected part in many healthcare information technology programs yet both the industry and academia have realized the importance of Business Intelligence

*Michelle Hoda Wilkerson et al. [5]*done work on youth reasoning with interactive data visualization and it deals with the youth understanding of data by interactive data visualization, they concluded that supporting learners in the coordination of any resources they choose to leverage is more likely helpful than supporting a particular approach or sequence of resource use

*Yuri Vanessa Nieto et al. [6]*done a work on academic decision-making model for higher education institutions with the help of learning analytics .it deals with modeling and construction of software architecture for creating and categorizing indicators and they concluded that proposed software architecture has benefit of providing integration of learning analytics indicators and supports decision making in universities.

VI. Methodology

In Power BI, the different types of data are fetched by means of getting data function from different data sources and the different data sources are Files, Database, Azure, Online Services and other, the detailed description of data sources as shown in details of data sources After selecting the Data sources, we have to get the data by means of queries (if the data source is other than files) or selecting files from folders. The data will be loaded in the Power BI tool and before making the report in the power BI tool, the uploaded data should be Analysed and Corrected for error freed data through edit queries function in data part of Power BI tool and we can have relations between different datasets by means of relationships part, As the option is seen at the left side of the power BI tool, if we required any conditional columns or to add new data in datasets by means of edit queries function we can proceed it and next step is to make report by means of clicking on report option and white empty sheet appears on the screen where we create our own report. The analyzed and corrected data is visualized by means of different Visuals such as Custom Visuals and Power BI Visuals such as stacked bar chart, stacked column chart and by means of Publish option the report is published on the Power BI Services. We have to log in to power bi services, if required we can do any editing operations otherwise the report is made into the dashboard by means of publish on the web

functionality and embed link is generated, the embedded link can be used in any websites for viewing dashboards by all end users as well as embedded link can be shared to any individuals. In this methodology, there are two types of modules as follows Faculty Module and Student Module. The Faculty Modules contains Student Internal Marks Progress and Placement Progression submodules and Student Modules contains only one module for viewing their data and there are explained as follows.

Pseudo Code Algorithms:

Pseudo Code Algorithm 1:

Start

Get 'P_i'

View 'P_i'

Initialise P_{at}, P_{t1}, P_{t2}, P_{ha}, P_q, P_{ch}, P_{ca}

Processing of P_i by means of string operations

Edit the dataset 'P_i' for adding new conditional columns P_{ap}, P_{am}, P_t, P_{ttm}, P_{fs}, P_{ape}, P_{t1pe}, P_{t2pe}, P_{qp}, P_{hap}using edit query function

Create new column P_{ap}

$P_{ap}=P_{ca}/P_{ch}*100$;

Create new column P_{am}

P_{am}= If P_{ap} ==100, 5

Else If P_{ap}>=95,

Else If P_{ap}>=90,

Else If P_{ap}>=85,

Else If P_{ap}>=80,

Else If P_{ap}>=75,

Else 0

Create new column P_{ttm}

P_{ttm}=If P_{t1}<P_{t2}, ((P_{t2}*0.75) + (P_{t1}*0.25))

Else ((P_{t2}*0.25) + (P_{t1}*0.75))

Create new column Pt,

$P_t=P_{at}+P_{ha}+P_q+P_{am}+P_{ttm}$

Create new column P_{fs}

P_{fs}=If P_t>=16, Promotion

Else If P_t<16, Detention

Else If P_{ap}<65, Detention

Else If P_{ap}>75&&P_{ap}<=100, Promotion

Else If P_{ap}>=65&&P_t>=16&&P_{ap}<75, Condonation

Else Error

Create new column P_{ape}

$P_{ape}=P_{at}/5*100$

Create new Column P_{t1pe}

$P_{t1pe}=P_{t1}/20*100$

Create new Column P_{t2pe}

$P_{t2}pe=P_{t2}/20*100$

Create new Column P_{qpe}

$P_{qpe}=P_q/5*100$

Create new Column P_{hape}

$P_{hape}=P_{ha}/5*100$

Visualize the above-considered variables using different Visuals

Publish the Report to power bi services

notations

P_i= Dataset of Students Internal marks from different data sources

P_{at}= Variable name of Assignment Test marks

P_{t1}= Variable name of Test 1 marks

P_{t2}= Variable name of Test 2 marks

P_{ha}= Variable name of Home Assignment marks

P_q= Variable name of Quiz exam

P_{ch}= Variable name of classes held

P_{ca}= Variable name of Classes Attended

P_{ape}=Variable name of assignment test performance

P_{am}=Variable name of Attendance marks

P_{ap}= Variable name of attendance percentage

P_t= Variable name of the total percentage

P_{ttm}=Variable name of test total marks

P_{fs}=Variable name of Final Status

X_{t1pe}= Variable name of Test 1 Performance

P_{t2pe}= Variable name of Test 2 Performance

P_{qp}= Variable name of quiz performance

P_{hap} = Variable name of Home Assignment Performance

Pseudo Code Algorithm 2:

Start

Get 'P_{ii}'

View 'P_{ii}'

Initialise P_{id} ,P_{na},P_{up},P_{Qf},P_{br},P_{st},P_{cn},P_{lp}

Processing of P_{ii} by means of string operations

Visualize the above-considered variables using different Visuals

Publish the Report to power bi services

notations

P_{id}= Variable name of id number

P_{na}= Variable name of the name
P_{up}= Variable name of UG/PG
P_{Qf}= Variable name of Qualification
P_{br} = Variable name of Branch
P_{st}= Variable name of Status
P_{cn}= Variable name of Company name
P_{lp}=Variable name of LPA

Pseudo Code Algorithm 3:

Start
Get 'P_{iii}'
View 'P_{iii}'
Initialise P_{ap}, P_{am}, P_t, P_{ttm}, P_{fs}, P_{ape},P_{t1pe},P_{t2pe}, P_{qp}, P_{hap}, P_{fs}, of similar variables to Algorithm1
Processing of x by means of string operations
Visualize the above-considered variables using different Visuals
Publish the Report to power bi services

As shown in the Pseudo code Algorithms 1,2, and 3 for different modules, Firstly the tool Programme is started and required data such as P_i, P_{ii}, P_{iii} in Algorithms 1,2 and 3 are captured into the tool from different data sources via getting data function and dataset is viewed if any corrections to be done for selected data and then data is initialized with multiple columns such as P_{at}, P_{t1}, P_{t2}, P_{ha}, P_q, P_{ch}, P_{ca}, P_{Api}, P_{am},P_{id}, P_{na}, P_{up}, P_{Qf}, P_{br}, P_{st}, P_{cn}, P_{lp}as shown in Pseudo-Code 1,2,and 3 respectively where different datasets contain a different number of columns. If required Uploaded dataset is processed by means of string operations, otherwise by means of queries conditional columns are created in datasets using edit queries as shown in pseudo code 1 and 2 with mathematical and conditional operations and then the dataset is Visualized through Microsoft Power Bi Visuals, by visualization of datasets report process is completed and then it is published to power BI Services by means of Publish function in the tool. After Publishing the report into the services of Power BI, the report is made into the dashboard by means of clicking publish on to web function in the file tab and then generated link can be shareable to anyone, it can be share to individuals of organization by means of Uniform Resource Locator (URL) directly or indirectly by means of SharePoint, Website,..Etc., as shown in the Results and discussion section.

VII. Results and Discussion

After publishing the dashboard to the power BI services it appears as shown in below figure and we can have some editing operations if any filters or visuals are not properly accessible then they can be rectified here before publishing on to the web. Not only above discussed modules, we can have dashboards of different modules of every educational institution, it may be related to staffs, Infrastructure and other Amenities of institutions...Etc. following are the results of dashboards of discussed modules of educational Institutions.

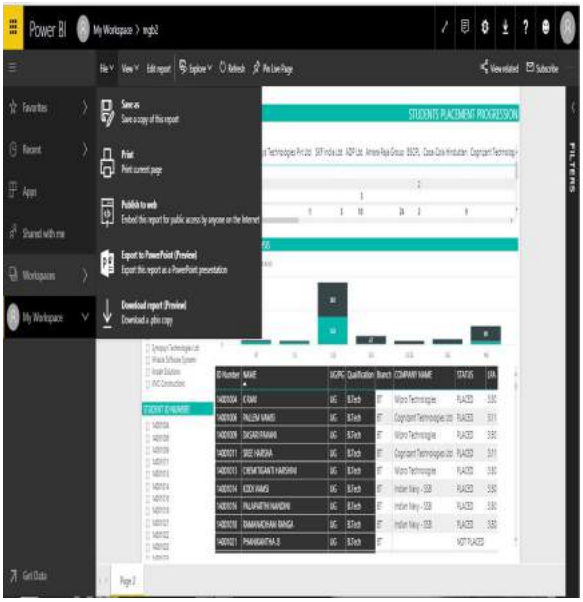

Fig. 3: View of publishing to web option A report in the Power BI Services

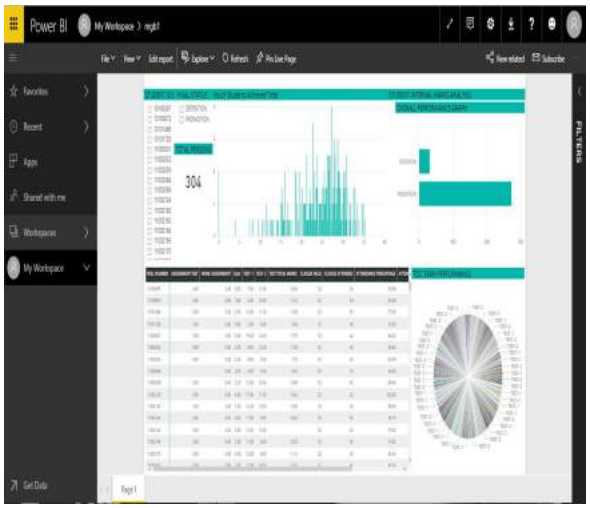

Fig. 4: View of Student Internal Marks Analysis

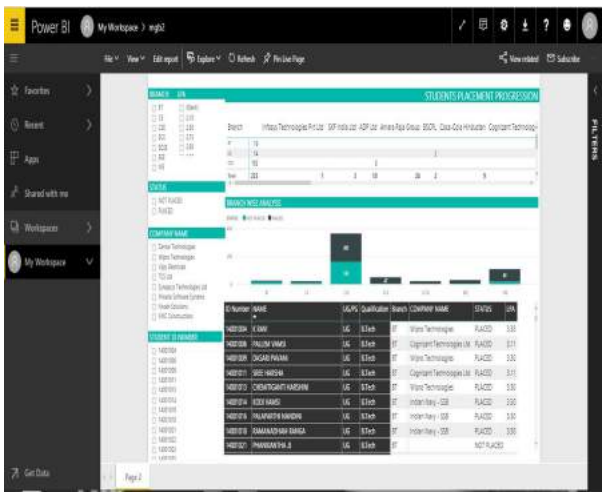

Fig. 5: View of Student Placement Progression

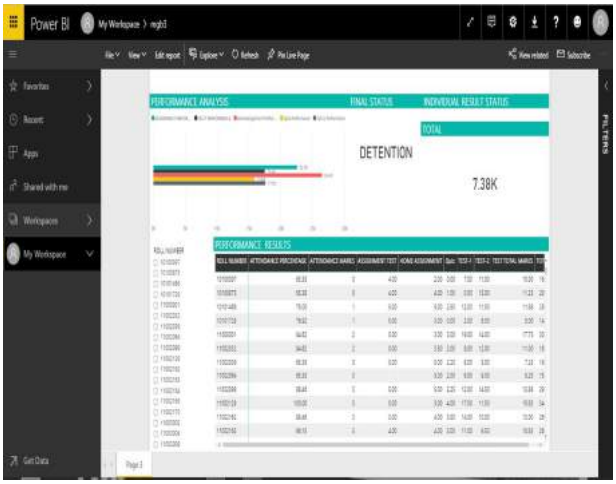

Fig. 6: View of Student Modules for viewing in the Power BI Services Purpose

After editing operations, the reports in the Power BI Services are shareable and kept into the web by means of publishing on to web option.

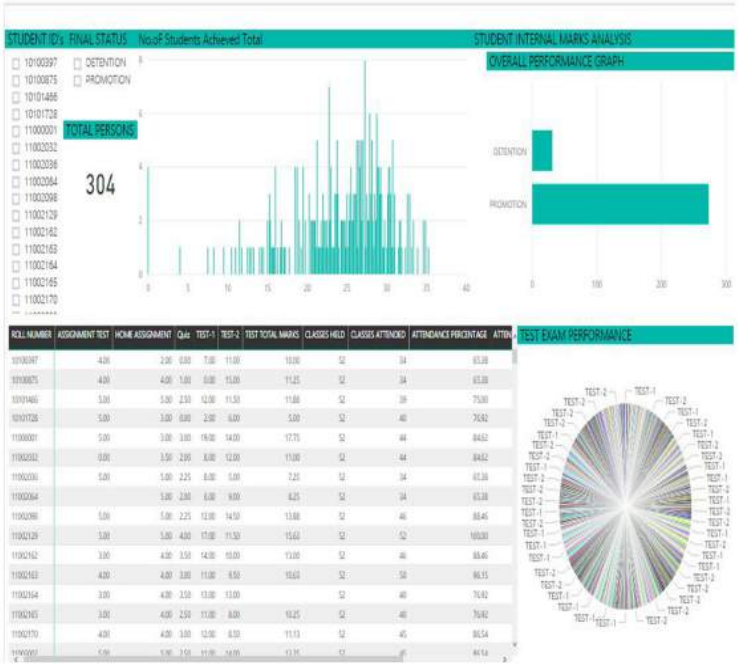

Fig. 7: View of Student Internal Analysis Dashboard in the web

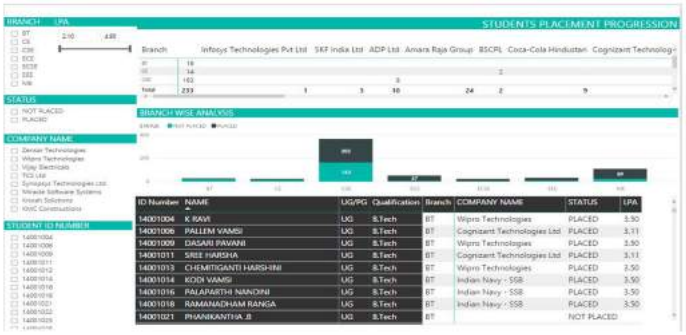

Fig. 8: View of Student Placement Progression Dashboard in the web

Fig. 9: View of Student view module Dashboard in the web

VIII. Conclusion and Further Work

Visualization of data is a very important thing in every organization and Business development, by means of visualization the end user or user can read the data easier and convenient to understand the data. In this paper we have visualized the educational institution database into three modules such as Placement Progression, Students Internal Marks and module of viewing purpose from student side by means of analyze and rectification of captured data from different data sources, The dashboards which are created using Power BI tool can be viewed by means of Mobile Applications such as Power Apps and Mobile Power BI ,Web such as by means of website or shareable link As a further work we can make other modules on Infrastructure related amenities such as quality of infrastructure provided, Staff-related issues such as feedbacks, work status, and other issues .

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Computation Model for Identifying Types of Diabetics using Multi-Selection Criteria Evaluation and K-Nearest Neighbor

By Towhidul Islam, Professor. Dr. Md. Nurul Mustafa & Jamir Ahmed

Southern University Bangladesh

Abstract- The main purpose of this topic is to develop a dynamic model of a Diabetes solution system. Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced such a deficiency results in increased concentrations of glucose in the blood. Which in turn damage many of the body systems in particular the blood vessels and nerves. Diabetes mellitus, often simply referred to as diabetes, is a group of metabolic diseases in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphonic (increased hunger).diabetes is data mining based notification systems. This system developed is main purposed the people easily treatment for accommodation.

Keywords: *classification diabetes, MCES algorithm-NN algorithm.*

GJCST-C Classification: *I.5.m*

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Computation Model for Identifying Types of Diabetics using Multi-Selection Criteria Evaluation and K-Nearest Neighbor

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Abstract- The main purpose of this topic is to develop a dynamic model of a Diabetes solution system. Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced such a deficiency results in increased concentrations of glucose in the blood. Which in turn damage many of the body systems in particular the blood vessels and nerves. Diabetes mellitus, often simply referred to as diabetes, is a group of metabolic diseases in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced. This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphonic (increased hunger).diabetes is data mining based notification systems. This system developed is main purposed the people easily treatment for accommodation. This system helps finds diabetes what type of diabetes type1, type2, & no diabetes easily provide this system. In this work, at first identity all the dependent variable or data to classify the suitable from unsuitable location. Then I have classified the data using Multi Criteria Evaluation System (MCES)[2].MCES helped the data set to be properly design and manipulated the system and K-Nearest Neighbor helped the diabetes range[1]. The main purpose of applying this identification is diabetes level. The concept of basically helped to build knowledge base. Most important of this topics collecting the real data for diabetes information.

Keywords: classification diabetes, MCES algorithm-NN algorithm.

I. Introduction

Diabetes solution is data mining based notification systems. This system developed is main purposed every people easily known diabetes patient. Then what kinds of diabetes type 1,type 2 & No diabetes lives and easily find out for accommodation. This system helps easily finds out type 1, type 2 & Nodiabetes identify. This system designed basically Multi Criteria Evaluation Systems (MCES) method used[2]. MCES computing the data set to be properly design and manipulated the system. The main purpose of applying this identification is to design a physical level. This system works, at first select different types Symptoms. Example: frequently urination, very thirsty. weight less increased hunger tried and weakness injured dry delay every see present itch bred few see eye blurry vision irritability tingling gum infections etc. Second step in test selection example OGT, FGT, Hbalc, ABF, HDL, Blood etc[4]. Each Criteria select based on need then test result provide. Then base test value so result provide type1, type 2 or No diabetes. Next scaling the each criterion diabetes level using K-Nearest Neighbor, K-Nearest Neighbor helped the diabetes range. Then type 1 range sum>=130.55mm & Hbalc>=6.5 then type 2 diabetes range sum>=130.55mm & Hbalc<6.5 then type 2 diabetes and range sum<=130.55mm then no diabetes [6]. The main purpose of applying this identification is diabetes level. The concept of basically helped to build knowledge base. Most important of this topics collecting the real data for diabetes information. Standardization of criterion scores particularly as sign the value. All the value defined between two intervals scores o and 1.The maximum value is score 0, the minimum value is score 1, the mid value is score 0.5 and other value in scores 0 and 1[2].When the patient search symptoms then gives the measurable for each criteria particularly importance of this criteria .Finally, this system select a perfect test result provide then drug suggestion and dose time.

II. Diabetes Mellitus

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced such a deficiency results in increased concentrations of glucose in the blood. Which in turn damage many of the body systems in particular the blood vessels and nerves. Diabetes mellitus, often simply referred to as diabetes, is a group of metabolic diseases in which a person has high blood sugar, either because the body does not produce enough insulin, or because cells do not respond to the insulin that is produced[4].

a) Because blood glucose very high

This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia

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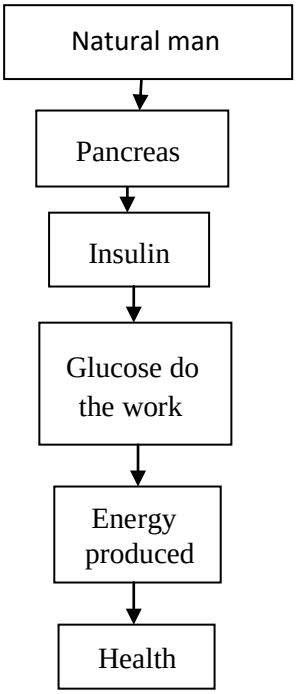
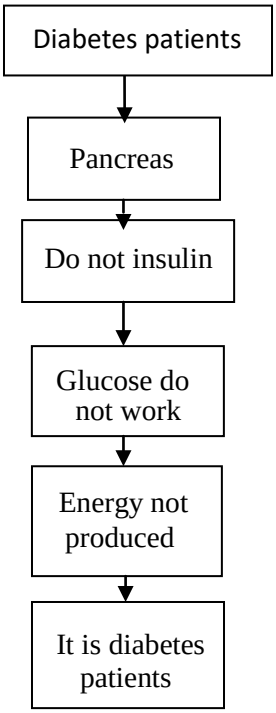
(increased thirst) and polyphonic (increased hunger: under the design of process natural man and diabetes man[4].

Design of Process: Non -Diabetes



Design of Process: diabetes patients



b) Symptoms

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced such a deficiency results in increased concentrations of glucose in the blood. Under the diabetes symptoms[4].

- Frequently urination
- Very thirsty.
- Weight less
- Increased hunger
- Tried and weakness
- Injured dry delay
- Every see present itch bred
- Few see eye
- Blurry vision
- Irritability
- Tingling
- Gum infections

c) Reason for diabetes

Which in turn damage many of the body systems in particular the blood vessels and nerves. Under the Diabetes reason for diabetes[6].

- Family father mother near relative to diabetes ineffective
- Weight very high
- Do not physical exercise and hardworking
- Longtime Cotswold medicine use

d) Conditions that cause diabetes

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the following conditions[6].

- Physical thickness
- Pregnant
- Injured
- Shock
- Surgery
- Mental contrariety

e) Principle forms of diabetes

i. *Type 1 diabetes:* insulin dependent in which the pancreas fails to produce the insulin which is essential for survival this form develops most frequently in children and adolescents but is being increasingly noted later in life. Type 1 diabetes, formerly called juvenile diabetes or insulin-dependent diabetes, is usually first diagnosed in children, teenagers, or young adults. In this form of diabetes, the beta cells of the pancreas no longer make insulin because the body's immune system has attacked and destroyed them. Treatment for type 1 diabetes includes taking insulin shots or using an insulin pump, making wise food choices, exercising regularly, taking aspirin daily (for some), and controlling blood pressure and cholesterol[6].

ii. *Type 2 diabetes:* non insulin dependent which results from the body inability to respond properly to the action of insulin produced by the pancreas. Type 2 diabetes is much more common and accounts for around 90% of all diabetes cases worldwide. It occurs most frequently in adults but is being noted increasingly in adolescents as well. Type 2 diabetes, formerly called adult-onset or non insulin-dependent diabetes, is the most common form of diabetes. People can develop type 2 diabetes at any age, even during childhood. This form of diabetes usually begins with insulin resistance, a condition in which fat, muscle, and liver cells do not use insulin properly. At first, the pancreas keeps up with the added demand by producing more insulin. In time, however, it loses the ability to secrete enough insulin in response to meals. Being overweight and inactive increases the chances of developing type 2 diabetes. Treatment includes taking diabetes medicines, making wise food choices, exercising regularly, taking aspirin daily (for some), and controlling blood presser. There are several signs and symptoms that indicate a person may have either pre-diabetes or undiagnosed diabetes[6].

III. MCES (Multi Criteria Evaluation System)

MCES is basically called decision making process. MCES provides a framework for exploring solution to decision making problem, which may be poorly defined. It is a method for combining data according to their importance in making a given decision. At a conceptual level, MCES method involve qualitative or quantitative weighting, scoring or ranking of criteria to reflect their importance to either a single or a multiple set of objectives .The main advantage of MCES is that they make it possible to consider a large number of data, relations an objectives which are generally present in a specific real world policy problem, so that the problem at hand can be studied in a multi dimensional fashion. Perhaps the simplest MCES is the weighted linear summation system .The steps involved in applying this system a diabetes solution system is illustrated in Figure 01and can be described as follows.

Step 1

At first select Symptoms and different test of selection criteria.

Step 2

Standardization criterion scores of their measurable. Most MCES analysis, especially those using quantitative and mixed data sources, require some form of standardization of the scales of measurement used by the data layers. This is necessary to facilitate the comparison of factors measures using different units and scales of measurement.

Step 3

Allocation weighted of their each criterion. This is done by adding weighted to reflect the importance of each criteria. A high level of importance done maximum of weighted and low level of importance done minimum of weighted.

Step 4

Finally, applying the MCES method. An MCES method may then multiply theses standardized scores by the weights for each of the data layers in stage 1 and sum these to allocate a score to each pixel on the output map. Further evaluation of the results may be carried out by ranking the values in the results map and reclassifying the ranked map to show the top ranked correct symptoms or Test. This test easily indicates then kinds of diabetes easily provide.

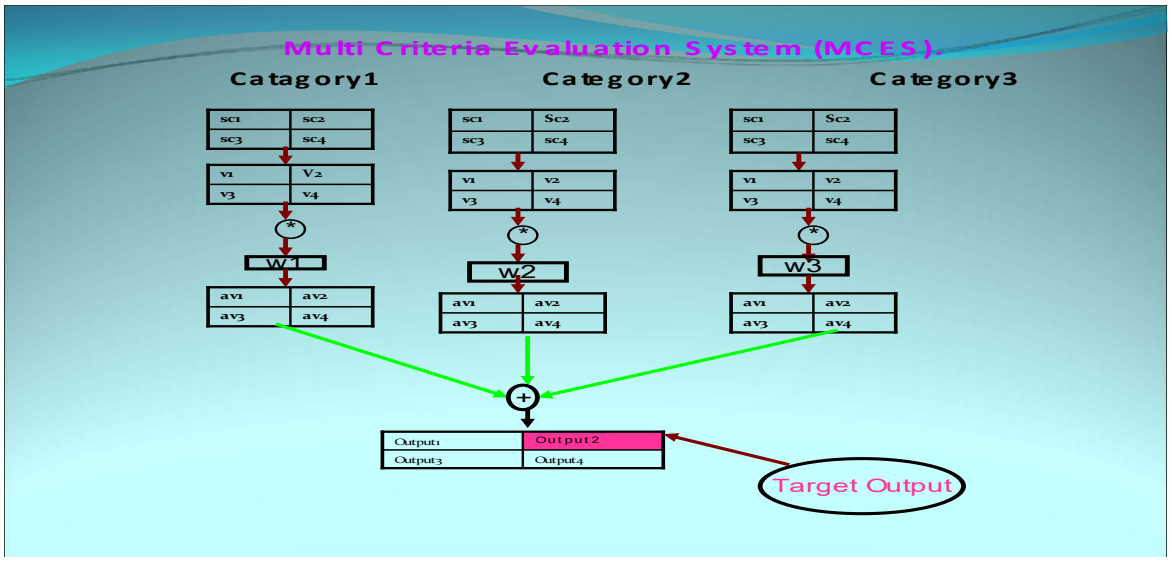


Fig. 1: Applying a linear weighted summation model in diabetes solution system

a) K-Nearest Neighbor (K-NN)

K–nearest neighbor (K-nn) algorithm is a branch of supervised learning[1]. Now-a-days it is being applying in various fields of data and information processing irrespective of science, commerce and arts. In the context of machine learning, K-nn is considered an effective data classification technique based on adjacent developed examples of sample space. The value of K is always positive and an object is classified by considering the greater number of choice of its neighbors. The neighbors are chosen from data set which is best fit for correct classifications and Euclidean distance helps to measure the overall distances. Here every occurrence correlates to points in sample space or within populations. Generally distance or similarity between instances or objects is easy if the data sets are numeric or integer. A very typical formula to calculate distances is Euclidian distances formula as follows:

$$d = \sqrt{(x_{w1}-x_{w2})^2 + (x_{w21}-x_{w22})^2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots a}$$

In some cases Manhattan or City Block distance also applicable:

$$d = (xw1-xw2) + (xwi-xwi2) + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots b$$

However it is very essential to bear in mind that all the instances at sample space must be same scale. As for example income will compare with income not the height of the human beings.

For qualitative data the distance measurement process will be different and it is important to consider that the instances are same or not. At this stage the qualitative objects are measured by allocating Boolean values to each object. It might be possible to converts to instances between which distance can be identified by some techniques. As for example color, temperature, age, height etc. Text and character has identified as one instance per word with the frequency start from 0, 1, 2……n.

b) The classifications process of K-nn as follows

The two main steps of K-nn must follow are:

1. Training
2. Predictions

Training means to get information from all sample spaces and populations. To accomplish this work we need to have the idea about the all instances and objects. In this sense it is very important to bear in mind that data set must be in same class. The qualitative and quantitative data measurement will be different. The predictions will manage by considering the predefined methods.

i. *The k-nn Algorithm*

The total algorithmic steps are as follows:

1. Parameter selections (int m, int n). m=0, n=1, 2, 3……n.
2. Distance calculation

$$\sqrt{\sum_{i=0}^{n} (q-p_i)^2} \qquad \text{where } i=0,1,2,3\ldots\ldots\ldots, n$$

3. Short the distances of sample space and marked the closet neighbors in the context of K-th smallest distance.

Input instances *h* with *n sample objects*, comparator *sum*

Output instances *sum* sorted according to *h*
if *sum. length*() > 1
Then (S_1, S_2) ← *divide*(*S*, *n*/2)
SHORT NEIGHBORS (S_1, C)
SHORT NEIGHBORS (S_2, C)
S ← SHORT NEIGHBORS (S_1, S_2)

4. *Similarities assumption:* Instances that are close together should have similar values.

Minimize

$$\xi(f) = \sum w_{ij}(s1-f_{s2})^2$$

Where w_{ij} is the similarity between examples i and j. And f_i and f_j are the predictions for example i and j.

5. Predict the value as follows:

Standard KNN

$$\hat{y} = \arg\max_y C(y, Neighbors(x))$$
$$C(y, D') \equiv |\{(x', y') \in D' : y' = y\}|$$

6. Find out the best heuristics distance

$$f(n) = g(n) + h(n)$$

Where:

- g(n) is the cost of the best path found so far to n
- h(n) is an admissible heuristic
- f(n) is the estimated cost of cheapest solution through n

c) New Maximum Nearest Area (NMNA)

How k-nn selects the desired values from a lot of alternatives is that it calculates its nearest most predicted value. The following figure depicts the computations.

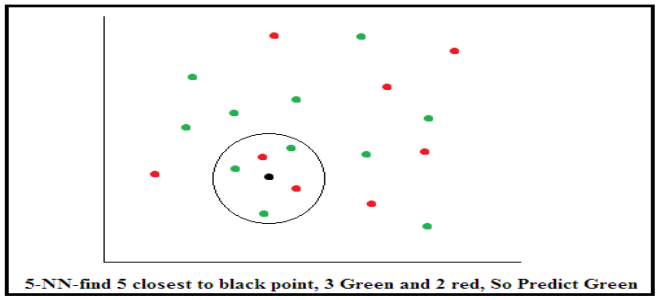


Fig. 3: The neighbor selecting process.

In the figure above we see that the small circle belongs three different color dots where the black one is

the pivotal element and based on that point we will calculate the green and other two green and red points. According to this figure we have to predict the green points as a K nearest neighbors. The neighbors are very closest to the pivotal point.

d) Organization of The Process

Now it is important to build the process how K-nn may organized in reality or the time line. To manage the proper training area we have to shorten the area or to select the appropriate area. When we are able to fix the sample area for computation, it will help us to reduce the computational complexity for entire process.

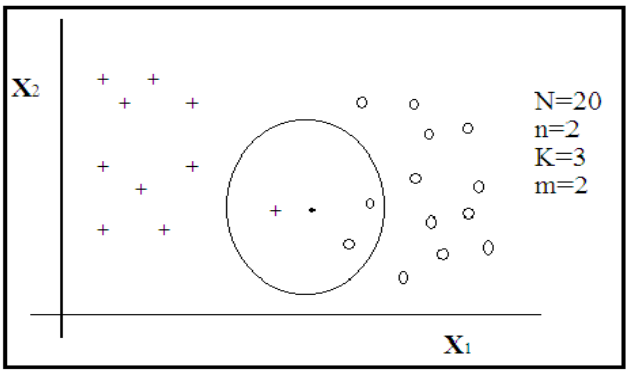


Fig. 4: The total population area for K nearest neighbors.

Here,

N= Total number of data set at population space. In this figure above we see that there is twenty (20) objects are outside the circle. The circle denotes the selected sample space. Inside the circle the black point indicate the pivotal or central point.

K=The total neighbors. Here the value of K is three (3).

n= indicate the nearest value.

m= categories of the neighbors. In the figure above we see that there are two categories of neighbors. One data set indicate by plus (+) sign and other is small hole.

IV. Data Analysis

A Data analysis is integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of data referenced information. Data analysis allows us to view, understand, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of measurement, globes, reports, and charts. Its can be integrated into any enterprise information system framework. The integration of data which may have been obtained from various sources, computerized at various scales, and based upon different projection systems, is a complex task and remains a major challenge. In a general sense, the term describes any information system that integrates stores, analyzes, shares, and displays data information for informing decision making. Finally, its can produced different types information is combined relation each other.

Diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following as shown in the table (1) which is diabetes diagnostic criteria. Fasting plasma glucose level≥ 7.0 mmol/l (126 mg/dl) Plasma glucose ≥ 11.1 mmol/l (200 mg/dl) two hours after a 75 g oral glucose load as in a glucose tolerance test Symptoms of hyperglycemia and casual plasma glucose ≥ 11.1 mmol/l (200 mg/dl) Glycated hemoglobin (Hb A1C) ≥ 6.5%[7].

Table 1: diabetes diagnostic criteria

Condition	2 hour glucose	Fasting glucose	HbA 1c
Unit	mmol/l(mg/dl)	mmol/l(mg/dl)	%
Normal	<7.8 (<140)	<6.1 (<110)	<6.0
Impaired fasting glycaemia	<7.8 (<140)	≥ 6.1(≥110) &	6.0–6.4
		<7.0(<126)	
Impaired glucose tolerance	≥7.8 (≥140)	<7.0 (<126)	6.0–6.4
Diabetes mellitus	≥11.1 (≥200)	≥7.0 (≥126)	≥6.5

Step 1

At first select symptoms and test of selection criteria. Most symptoms & test is selected based then kinds of diabetes provide. Example then Showing bellows:

Table 1: At first select symptoms and test of selection criteria.

Kind of diabetes	Criteria 1	Criteria 2	…….	Criteria 11	Criteria 12
Type1/Type2/No Diabetes	Thirsty	Weakness	…….	OGT	Hbalc
"	"	"	…….	"	"
"	"	"	…….	"	"

Step 2

Secondly, scaling the each criteria particularly and assign the value or (measurable). Showing bellow:

Table 2: Scaling the each criteria particularly and assign the value

Kind of diabetes	Thirst	Weakness	……	OGT	Hbalc
Type1	5	3	…….	130	6
Type2	1	0	……..	150	10.5
No diabetes	2	1	……..	135	00

Step 3

Standardization of criterion scores particularly distances value. All the value defined between two intervals scores o and 1.The maximum value is score 0, the minimum value is score 1, the mid value is score 0.5 and other value in scores 0 and 1. This score create the based on equation (This equation only one location). Showing bellow:

Thirsty= (thirsty _max- thirsty _value)*1/(thirsty _max- thirsty _min);
Weakness= (weak _max- weak _value)*1/(weak _max- weak _min);
OGT= (ogt _max- ogt _value)*1/(ogt _max- ogt _min);
Hbalc= (hbalc _max- hbalc _value)*1/(hbalc _max- hbalc _min);

Table 3: This score create the based on equation (This equation only one location)

Kind of diabetes	Thirsty	Weakness	……	OGT	Hbalc
Type1	1	0	…….	130	0
Type2	0	0.2	……..	150	0.5
No diabetes	0.5	1	……..	135	1

Step 4

Next, weight adjustment each criteria particularly importance for client. After multiply weight and criterion score. Using this equation is showing bellow:

Thirsty= (thirst _max- thirst _value)*1/(thirst _max- thirst _min)*weight_ thirst;

Weakness= (weak _max- weak _value)*1/(weak _max- weak _min)*weight_ weak;
OGT= (ogt _max- ogt _value)*1/(ogt _max- ogt _min)*weight_ ogt;

Table 4: weight adjustment each criteria particularly importance for client

Kinds of diabetes	Thirsty	Weakness	…	OGT	Hbalc
Type1	1*0.6=0.6	0*0.4=0	…	530*0.3=159	8
Type2	0*0.6=0	0.2*0.4=0.08	…	450*0.3=135	6.5
No diabetes	0.5*0.6=0.3	1*0.4=0.4	…	135*0.3=40.5	5

Step 5

Finally, Add the all criteria value .Which totals are maximum this symptoms & test are selected. Using this equation is showing bellow:

Totals=Thirsty+ Weakness+……..+OGT+Hbalc;

Table 5: Totals are maximum this symptoms & test are selected

Kinds of diabetes	Thirsty	Weakness	…	OGT	Hbalc	Totals
Type1	0.6	0	…	159	0	159.6
Type2	0	0.08	…	135	0.05	135.13
No diabetes	0.3	0.4	…	40.5	0.1	41.3

a) Total finally result

Table 6: Total final result

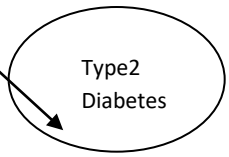
Kinds of diabetes	Criteria 1	Criteria 2	…….	Criteria 11	Criteria 12
Type1	Thirsty	Weakness	……..	OGT	Hbalc
Type2	‘’	‘’	…….	‘’	‘’
No diabetes	‘’	‘’	……..	‘’	‘’

Kind of diabetes	Thirsty	Weakness	……	OGT	Hbalc
Type1	50	300	…….	5500	2
Type2	120	100	……..	1500	3
No diabetes	100	50	……..	2500	1

Kind of diabetes	Thirsty	Weakness	……	OGT	Hbalc
Type1	1	0	…….	0	0
Type2	0	0.2	……..	1	0.5
No diabetes	0.5	1	……..	0.6	1

Kind of diabetes	Thirsty	Weakness	……	OGT	Hbalc
Type1	1*0.6=0.6	0*0.4=0	……	0*0.3=0	2
Type2	0*0.6=0	0.2*0.4=0.08	……	1*0.3=0.3	8
No diabetes	0.5*0.6=.6	1*0.4=0.4	……	0.6*0.3=0.18	1

Kind of diabetes	Thirsty	Weakness	…	OGT	Hbalc	Totals
Type1	0.6	0	…	0	2	2.6
Type2	0	0.08	…	0.3	8	8.43
No diabetes	0.3	0.4	…	0.18	1	1.98



Then final result provide. Look at the bellow.

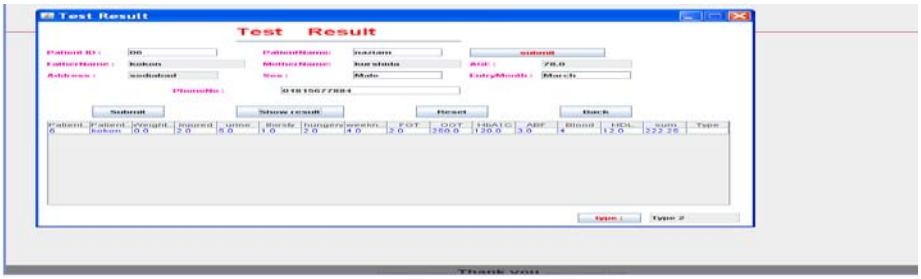


Fig. 4: Showing the test result Type2 diabetes

Note: one patient come at first entry, then symptoms selection then this system test provide then test selection then final test result provide this system provide type1 or type 2.

V. Conclusion

The main goal of Computation Model for Identifying Types of Diabetics Using Multi-Selection Criteria Evaluation and K- Nearest Neighbor algorithm is to get best algorithms that describe given data from multiple aspects. There are different diabetic's symptoms classification algorithm that can be used for the identification of diabetes disease among patients. In this paper two classification techniques (MSCE, K-NN) are applied to predict the diabetes disease in patients. The algorithms are very necessary for intend an automatic classification tools. In our study first the two techniques were first filtered by using the computing time in which MCES helped the data set to be properly design and manipulated the system and K-Nearest Neighbor helped the diabetes range. The main purpose of applying this identification is diabetes level.

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Application of Ethereum Smart Contracts in Purpose of Generating New Cryptocurrencies

By Jovan Toroman

Abstract- As Bitcoin's popularity increases so does the familiarity with cryptocurrencies in general. Ethereum is one of the most popular platforms in the cryptocurrency world. Development of a cryptocurrency using programming language Solidity and Ethereum platform is presented in this paper. Following the development, possible utilization of this cryptocurrency will be discussed.

Keywords: *crypto currency, security, systemstructure, ethereum.*

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I. Introduction

Modern human civilization is based on the trade process. By the means of trading, people from the original communities managed to obtain the necessary resources they could not produce or procure in any other way, while at the same time exchanging their products and resources for other resources [1]. Later, currencies were introduced, so that they could be traded more easily, and exchanged for various necessary resources.

With the emergence of currencies, the first centralized entities that take control and distribution of currencies also appear, thereby enabling or disabling participants in the free market [2]. In this way, the absolute ownership of money belongs to small groups of people, which are mostly its richest owners who determinerules of the game and participation in systems where certain currencies are used.

One solution to this problem of lack of freedom in trade mediation, as well as the control of total capital by a third entity was found in cryptocurrencies. Cryptocurrencies as a concept allow for creation of the representation of material goods by relying on the cryptographic integrity of use, regardless of the field of application or usage of money. With their use, it is possible to have a distributed and decentralized system of trade with money that has an equal value among all the entities participating in the exchange.

In this paper, Chapter 2 gives an overview of the cryptocurrencies. Chapter 3 describes the Ethereum platform. Chapter 4 explains the notion of smart contracts, while in Chapter 5 we deal with the creation of cryptocurrencies using the Ethereum platform. Chapter 6 gives the conclusions of the work outlined in the previous chapters.

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II. Cryptocurrencies

Cryptocurrencies were designed with the same purpose as the standard currencies - to enable people to exchange goods more easily. However, what distinguishes the existing cryptocurrencies from the standard currencies is the way they are issued, as well as how financial transactions are performed. Instead of the standard situation where the central bank issues and affects the value of money, with cryptocurrencies this process is completely decentralized. The way in which this is done is precisely the usage of cryptographic methods.

Cryptocurrencies as a concept tookthe attention of the publicin January 2009, with the emergence of Bitcoin - the first cryptocurrency that is at the same time a decentralized payment system [3]. Designed by, until that moment unknown, Satoshi Nakamoto, the main purpose of Bitcoin was to create a fully decentralized currency, where mediation of financial institutions is not necessary for its exchange [4].

Given that there is no centralized financial institution, such as a central bank or money mint, how are cryptocurrencies created and how is their value determined? In the case of Bitcoin, like the vast majority of other cryptocurrencies, the mining process creates cryptocurrencies that are then distributed to "miners" by a particular algorithm, most often using the Proof of Work algorithm [5]. Mining represents the process of recording and confirming transactions within the decentralized network into the chain of blocks-blockchain. Blockchain represents a distributed database representing the history of all recorded transactions made using Bitcoin [6]. The constituent element of the blockchain is a block - the currently active part of a database that records all or most of the recent transactions [7]. Each block contains a reference to the previous block in the chain, all the way to the initial block - genesis block. In the case of Bitcoin, as a reference cryptocurrency, each block also contains a "puzzle" that must be solved so that the block can be marked as completed. It is in the form of conditions that a cryptographic hash function must satisfy for a certain value. The first value that permits the fulfillment of the puzzle is the solution of the block and the computer (or groups of computers) that participated in its calculation is rewarded for the spent computer resources. The award is presented in the form of Bitcoin, which is then

distributed among the participants in mining. Initially, 50 Bitcoins were awarded for solving each block, but this amount is reduced after every 210,000 blocks resolved so that Bitcoin's inflow would be proportional to their value and the difficulty of puzzles added to each new block [8].

III. Ethereum

Ethereum is a distributed open source platform that uses blockchain to enable usage of smart contracts. By applying virtualization techniques, it is possible to execute various commands like on a distributed nodal network. Ether denomination is used as the propelling agent of these commands (transactions). In this way, it prevents accumulation of irrational tasks in the nodes of the network.

Due to the collapse of The DAO organization, the Ethereum has collapsed into two chains. The chain with a smaller number of users got the new name Ethereum Classic, while the popular bridle retained the old name. This happened because of a security breach in one of the applications, where attackers managed to return the Ether over recursive calls several times before updating the balance of the smart contract itself. Unfortunately, it turned out that it is not possible to easily undo new transactions. Due to disagreement over whether the ether should be returned to the original owners, at the expense of some of the basic principles of functioning of the platform, or other option-continuation without changes, the aforementioned division occurred.

IV. Smart Contracts

Smart contracts are one of the features of the cryptocurrencies and the decentralized payment system Ethereum. They allow that on a particular Ethereum address, there is a computer program along with it's associated data (its state) which enables automatic cryptocurrency management [9]. Changes made by calling this program are recorded and registered in Ethereum blockchain. Smart deals are presented with Turing's complete machine, but there are opinion currents which suggest that it is not the best solution in the case of smart contracts [10].

Each Ethereum smart contract is executed on the Ethereum Virtual Machine (EVM), so there is a degree of isolation of smart contracts from the operating system where it is executed. In addition, there is a degree of isolation between other smart contracts that are executed on the same EVM instance. The Ethereum address of a smart contract, unlike the Ethereum user address that represents its public key, is determined using the public key of the creator, the time when the contract was created and the number of transactions that the owner of the smart contract has done [11]. Based on this, we can conclude that smart contracts have been made by their creators and owners.

When performing each transaction using smart contracts, each transaction is charged by a certain amount of "gas" resource - which at the time of writing this work is 0.00000002 ether or 22312210827 wei. The gas is a value derived from the ethereum used to charge the use of the Ethereum Transaction Processing Network and is set by the transaction maker so that it is possible that persons who mine transactions refuse to execute transaction due to an unfavorable gas price [12].

Ethereum smart contracts are written using the Solidity programming language that supports concepts from object-oriented languages, such as inheritance and static typing [13]. Because of the possibilities it provides and because it is based on already existing programming languages, Solidity allows you to create a large number of different smart contracts.

```
pragma solidity ^0.4.0;
contract SimpleStorage
    {uint storedData;
    function set(uintx) {
      storedData = x;
   }
function get() constant returns (uint) {
      return storedData;
  }
}
```

Figure 1: An example of a smart contract that allows you to enter and read the stored value at the smart contract address.

As it is possible to observe from the above example, there are minimal barriers to the development of smart contracts using the Solidity programming language, judging by the fact that it is based on the syntax of different programming languages, such as C and Java.

V. Usage of Solidity and Ethereum Platform for Creating a Cryptocurrency

As we defined in the introduction, cryptocurrencies as a concept allow for creation of representations of material goods, relying on the cryptographic integrity of use, independentfrom the field of application or usage of money.

The cryptocurrency we will create will be different in contrast to Bitcoin or Ethereum. Namely, we will have an administrator of the cryptocurrency who will represent it's owner, who can also create new instances of cryptocurrencies. The crypto administrator will be a

person with a specific Ethereum address. It is possible that the crypto administrator is an address belonging to a smart contract that can automatically, if it is so constructed, create and cancel the amount of cryptocurrency in relation to another external factor (such as aligning with a course of another currency or even the movement of another cryptocurrency). In addition, it is important to note that, for the purposes of the case, we will not use Proof of Work [14], Proof of Stake [15] or Proof of Burn [16].

Launching a smart contract, and therefore cryptocurrency, is done using Ethereum Wallet [17]. To begin the development of cryptocurrency, it is necessary to have a minimal set of functionalities: the collection of all addresses with the amounts of our cryptocurrency, the initial amount of cryptocurrency, the address where the initial amount of cryptocurrency is located (in our case crypto administrator), and a function that allows the transfer of cryptocurrencies between different addresses (which may belong to other people or smart contracts, and are linked to the Ethereum network).

```
contract MyToken {
   /* Creating an array with all
addresses and balances */
   mapping (address => uint256)
   public balanceOf;
  /* Initializes a contract with the
 initial amount of cryptocurrency allocated to the creator
of smart contract */
   function MyToken(
    uint256 initialSupply
    ) {
   balanceOf[msg.sender] =
initialSupply;
//   Give the creator all the
//   units of the cryptocurrency
    }
/*Cryptocurrency transfer function*/
function transfer(address _to,
uint256 _value) {
       if (balanceOf[msg.sender] < _value)
throw;
//   Check that the sender has enough
//   cryptocurrency units
     if (balanceOf[_to] + _value
<balanceOf[_to]) throw;
//   Checking the quantity overflow
//   balanceOf[msg.sender] -= _value;
//   Subtract from the sender
        balanceOf[_to] += _value;
//   Add to recipient
     }
}
```

Figure 2: Example code for the smallest functional smart agreement that creates a new cryptocurrency

With the example code above, after loading it as a smart contract within Ethereum Wallet, we have the ability to distribute cryptocurrencies to other interested parties. As already stated, in order for the smart contract to become active and in order for it to be correct, it is necessary to spend a certain amount of gas, which represents a kind of fee paid to the Miners of the Ethereum network in order to confirm the creation of smart contract and transactions belonging to it.

Adding cryptocurrency administrators is done by inheriting a smart contract that defines the behavior of the cryptocurrency administrator. A description of the behavior that needs to be implemented in a smart contract for cryptocurrency administrator is contained within the Solidity documentation [18].

```
contract owned {
   address public owner;
   /* the cryptocurrency owner's address which was set
when originaly setting up the smart contract */
  /* function to check
cryptocurrency ownership */
   function owned() { owner = msg.sender;
}
/* checking if there is only one
 owner */
    modifier onlyOwner {
       if (msg.sender != owner) throw;
        _;
}
/* function to transfer
cryptocurrency ownership*/
    function transferOwnership(address
newOwner) onlyOwner {
      owner = newOwner;
   }
}
```

Figure 3: Example of a contract used to define the cryptocurrency administrator

The inheritance of the contract is done using a keyword "is" in the definition of a contract from which we

want to inherit it, so in our case, the definition of the MyToken contract is as follows:

```
contract MyToken is owned
```

Managing the available amount of cryptocurrency is possible by adding one variable and one function. The variable monitors the total number of available amount of cryptocurrency, while the function modifies the variable, thus altering the total amount of available cryptocurrency, taken that only the cryptocurrency administrator has the ability to change the cryptocurrency in circulation.

It is necessary to define the totalSupply variable that will represent the total available amount of cryptocurrency in circulation:

```
uint256 public totalSupply;
```

It is also necessary to add the starting amount of available cryptocurrency to the smart contract constructor, so that, when creating a contract, we would have an insight into how many cryptocurreny units are available.

```
totalSupply = initialSupply;
```

The function that deals with the change in the available amount of cryptocurrency in circulation is as follows:

```
function mintToken(address target, uint256 mintedAmount) onlyOwner {
    balanceOf[target] += mintedAmount;
    totalSupply += mintedAmount;
    Transfer(0, owner, mintedAmount);
    Transfer(owner, target, mintedAmount);
}
```

This function uses the previously defined Transfer function to perform the transmission of the modified circulation of cryptocurrency to the cryptocurrency administrator address.

VI. Conclusion

The application of the concepts outlined in this paper opens numerousinteresting possibilities. Creating different cryptocurrencies is simple with this kind of infrastructure, and on the otherside, there is great freedom in terms of the amount of currency in circulation as well as the way transactions are performed.

Such a concept is applicable in different scenarios.One of the most interesting is the game industry.In fact, computer games are one of the first examples of virtual currencies. It is often the case thata game allows you to purchase different items and functionalities. A virtual currency is a simple way of transferring value from one game to another, as well as it's transformation into other goods. This is especially interesting for smaller development teams that can have significant benefits by merging into an ecosystem with other teams using a common cryptocurrency.

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Rework and Reuse Effects in Software Economy

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Abstract- Software industry supposed to provide software product to their customers at a lower price and right time. Unfortunately, it's true that the industry can't deliver the software at lower a price. Lots of reasons are responsible for this high price of the Software. Such as high wages of stakeholders, the size of software, testing costs, implementation cost and one of the most vital reasons is a rework that increases the cost of software. In this research paper, I focused on rework and reuse, its cost & effect on software economy. How to reduce the rework during the software development life cycle-SDLC. This research found that a long part of the development duration used for rework. This scenario is not only obtainable in a small software firm but also medium and enterprise software companies. Rework issue is one of the big challenges of the software industry. This research explained the problem in a financial point of view and provided needed suggestions to reduce the rework & increase the reuse based on software engineering body of knowledge. The software industry will be profitable if they can reduce the rework and upsurge the reuse of software.

Keywords: *software, rework, reuse, economy, quality, time, cost, stakeholders.*

GJCST-C Classification: *K.6.3*

Strictly as per the compliance and regulations of:

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I. Introduction

Rework is an ongoing problem in the software development process. Rework is generally considered to be potentially avoidable work that is triggered to correct problems or to tune an application (Aaron G. Cass, 2003). Many software firms are confused to isolate the rework. They think we are working to solve the existing problem & it is part of our maintenance, routine work. Now the point is how to differentiate the rework. Rework in software development is the additional effort of redoing a process or activity that was incorrectly implemented in the first instance or due to changes in requirements from clients (Vimla Devi Ramdoo1, 2015). Rework is defined as work measures that have to be completed more than once (Robin McDonald, CCM, LEED G.A., 2013). Peter E.D. Love1 characterized rework as the "unnecessary process of redoing a work activity that was incorrectly carried out the first time." Another definition which emphasizes the essence of rework is "work that is made to conform to the original requirements by completion or correction at least one extra time due to non conformance with requirements". The term rework is clearly defined here. Now the question is what is the source of rework? How can we reduce the rework? What is the cost of rework and what is the effect of rework in the software economy? This research paper not only answering these questions but also explaining the benefit & values of reuse. The term "Reuse" is used for developing the software by using the existing software components. These reusable components are projected assets. This research recommends to software engineers for design and develops software in such a manner so that a software component can be reused in multiple software. This research found that a few software firms are using existing reusable components, but the number of reuse is not satisfactory. Maximum components of the new software are being developing from scratch. Because the existing software components didn't build for reuse. Although some components of previous software were developed for reuse, but all of those components are impossible to reuse due to technology upgrade and requirements changes. The ratio of reuse of already available software components is very limited. It is one of the barriers to the success of the software industry.

This research was performed in a few software companies on multiple projects. A single project is not suitable for this type of research because let's say the first project is fresh it has no reusable component. The first project will develop reusable components. Then in the next project development, reusable components of the first project can be reused. But at the first project, the chance to rework can't ignore. Software reuse is accomplished by creating programs from previously developed software modules (Robert W.Therriault, 1994). Reuse is expected to lead to reduced system development time arid maintenance while increasing reliability by using existing working modules (Robert W.Therriault, 1994).

II. Purpose

The main purpose is to increase existing reuse levels to at least one step upper level and reduce the rework at least one step lower level. Development of project assets for decreasing rework and increasing reuse level of Software, Company. To meet this purpose Software Company must identify.

1. What is their current rework level ?
2. What is their current reuse level ?

First of all, defines the current position of the company where it exists now in rework and reuse level criteria. It is the very important job for software firm and complicated to define the level. A lot of the sensitive issues involved with it. If Software Company can't measure the current level of rework and reuse, then it can't estimate target level.

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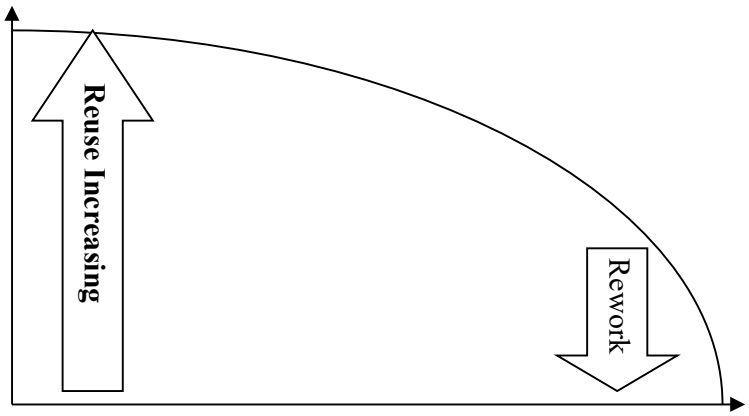

Figure 1: Purpose

Measurement of effect for rework & reuse: The effect of rework and reuse is measured by settings some performance parameters. One parameter is proportionally related to another. Some parameters are upward and some of them are downward. Upward parameters tend to the opposite with downward factors. Such as, if reuse arises, then time will fall, rework will fall, the development cost will drop. If project time rises, then the project cost will increase. The ultimate goal is to save the time, reduce cost and increase the profit margin. Here time and cost will sink parallel way with sinking rework. Profit will increase with the increase of quality & reuse.

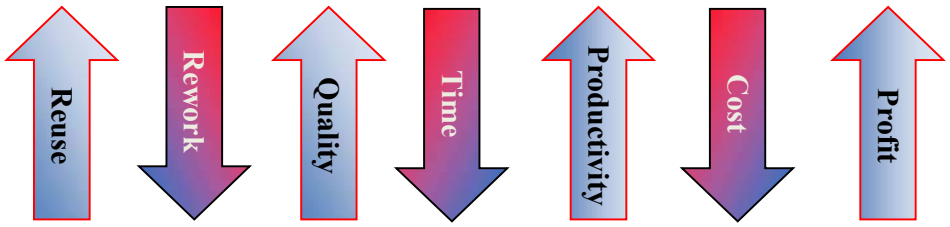

Figure 2: Effect Measurement Parameters

The rework, cost & time are expense related heads. The reuse, quality, productivity & profit is income associated heads. The opposite is happening when downward parameters grow up, and upward constraint goes down. When a rework is arisen in any part of a project such as, in a specific module or, same is happening in a small component, then the time of development is raising instantly. As a result the cost of development rises. The price may be $1 to $1000, depends on the project, its stage of SDLC and on the type of rework. Oppositely when there is no reuse, or the race becomes very limited in a project, then its quality may be having suffering, productivity may collapse and profit margins may plummet.

Actually, every software company want to

- Reduce project time
- Reduce project cost
- Reduce rework
- Reduce customer dissatisfaction
- Increase reuse
- Increase quality
- Increase productivity
- Increase profit

If rework is decreased, then time will cut cost will shrink finally the profit margin of the company will upturn. If the reuse is increased then, the time of development will save, the cost of perfection will diminish ultimately the growth of revenue will upsurge. The major factor is R2. Reduce the Rework and increase the reuse. That is the prime focus of this research paper.

Project Assets: Project assets are the reusable component of a project of a company. Project asset is developing by the predefine process. A process has multiple elements such policy, procedure up to 10^{th} elements based on manner. A procedure that has followed ten elements known as standard method and the component that developed with this ten elements is the reusable component.

1. Purpose or Output
2. Performance Parameters
3. Policies
4. Procedures
5. Standards
6. Knowledge, Skills & Environment
7. Tools & Techniques
8. Measurements

9. Control
10. Improvement

For example a Bank account opening form, it is projected assets of the Bank. The predefined format is the standard of the Bank, the printed hard copy of account opening form and pen are the tools. Bank reuses the form information of customers that reduce Bank staff rework and save Banking times. That directly saves the cost of overtime work of the Bank. For the purpose of finding out current rework and reuse level first of all need to figure out five projects.

Following are a list of five projects:

Project Code	Name of the project	Nature of the project	Stakeholders	Remarks
P001	Hospital Management Information Software	Health Care Information System	Renown Hospital and Diagnostic Laboratories	
P002	Eye Care System	Ophthalmic EMR	Renown Eye Hospital and Institute	
P003	Trade Marketing & Distribution system	Manufacturing and Distribution System	Group of Company	
P004	Pharmaceutical ERP	Web Based Interactive ERP	Joint Venture Company	
P005	Digital Health Card System	GPRS Health Tracking	Government Staff	

Figure 3: List of five projects

a) Advantages of reuse of software components

Software reuse can cut software development time and costs. The major advantages of software reuse are to:

- Faster time to market
- Less effort
- Time-saving
- Increase software productivity.
- Utilize fewer resources
- Shorten software development time.
- Improve software system interoperability.
- Develop software with fewer people.
- Move personnel more easily from project to project.
- Reduce the systems development expenditures
- Reduce the software implementation and maintenance costs.
- Produce more standardized software.
- Produce better quality software and provide a powerful competitive Advantage.
- Leads to better quality software
- Reduce bugs

Reusable component development phase: In any phases of the software Development life cycle-SDLC, software engineers can develop reusable components. For example requirements specification stage, coding time, documentation segment design part, etc. Let say in requirement specification period, the requirement engineer detected that a requirement is repeated over several systems. So the engineer has to note that this portion of chucks corresponds to the well-defined set of necessities, modules then the engineer can reasonably expect to be able to reuse the requests Module. Similarly, in the coding level when a coder sees the same code is needed to write in multiple blocks, then coder can create a function, or it may be others object depends on the programming language that is used and it can be used, or call at any chunk of code where necessary. The software engineer can reuse the design of the existing subsystem as the design of the new subsystem, the test plan of the existing subsystem as the test plan of The new subsystem as well as others subsystems. Engineers can reuse existing the database schema for new database schema and create new object as well as Modify existing objects as per necessity. Reusable component development is not Phase dependent. Software reusable component can develop in any phase of development life cycle.

Reusable components of a software: Software reuse is accomplished by creating programs from previously developed Software modules. Many different aspects of software can be reused. Some of the constituents that can be reused are as follows:

- Plans
- Software requirement specifications
- Source code
- Software architecture
- Design and user interface
- User manuals
- Software documentation
- Database
- Algorithms
- Test case
- Templates
- Tools
- Procedure
- Plugins
- API
- Queries, reports
- Concepts and domain knowledge
- Implementation & experiences
- Objects and text
- Process
- Library
- Artifacts
- Modules
- Master setup data
- Models
- Themes
- Function
- Package
- Dynamic action
- Template

b) Reuse percentage of software components

Several studies into reuse have shown that.

40% to 60% of the code is reusable from one application to another.

60% of design and code are reusable in business applications.

75% of program functions are common to more than one program.

15% of the code found in most systems is unique and new to an application.

15% to 85% rates of actual and potential reuse range (Florinda Imeri, 2012).

Here the maximum number of reused components is the user-defined function program. It is very easy, and friendly to reuse user-delineate function and procedure from one software to another software or from one software module to another module within the same software. Such as current age calculation within date of birth. If a programmer creates a job that will return current age year month day passing the parameter date of birth then it can be used for employee age calculation or same function can be reused for patient age calculation or same function can be reused for customer age calculation. This is suitable for reuse in any module within software as well as in other software. This component will reduce rework and save development time. The next place, of the maximum reused stage is the design part. Here design means software architecture design, database design, user interface design, platform design, and security design, etc. The reusable design saves time and cost. Design phase encourages increasing the reusability.

c) Reuse's Shortcomings

Software reuse is hindered by issues. All-time reusable code is not a cure-all for Programmers and does not always provide significant benefits. Quite often maintaining old programs or developing shell scripts for reuse of old code is overlooked. A brief discussion of the important issues is as follows (Robert W.Therriault, 1994).

- Inadequate documentation/training/awareness
- Startup and maintenance costs
- Inflexible design/will cost too much to modify
- Legal problems
- Domain irrelevance
- Technical Difficulty
- Complexity
- Team members conflicts
- Difficult to identify reusable component's
- The technical factor that hinders software reuse is poor conceptualization.
- Additional costs associated with understanding, modifying, certifying, and maintaining the reusable components.

d) Examples of successful software reuse

There are many examples of successful software reuse. Several success stories were cited by Charles Lillie at the Second Annual Reuse Education and Training Workshop. These include:

- 312 projects in the aerospace industry, with averages of
  20% increase in productivity.
  20% reduction in customer complaints,
  25% reduced time to repair, and
  25% reduction in time to produce the system.
- A Japanese industry study that noted
  15-50% increases in productivity.
  20-35% reduction in customer complaints,
  20% reduction in training costs, and
  10-50% reduction in time to produce the system.
- A simulator system developed for the US Navy with an increase of nearly 200% in the number of source lines of code produced per hour.
- Tactical protocol software with a return on investment of 400%.

- A NASA report lists reductions of 75% in overall development effort and cost. These are impressive success stories. They clearly indicate that software reuse is a technique that can have a positive impact on software engineering practice in many environments (Ronald J. Leach, 2011).

The above example is the reflection of reuse. It is amazing. 20% to 25% Productivity increase is not a small deal. These examples will influence another company for increase their reusability. Increasing the reuse means reducing the rework that reduces cost and time. As a result profit margin will rise. That is the ultimate goal of this research.

III. Original Work vs. Rework

Software development works in a project typically include the development of new features, changes to existing features, and fixing reported feature defects. The journey from start to finish for these tasks may follow different paths described regarding time spent doing two types of work: original work and rework. Original work in this context is a metric which assesses how much initial time/effort was spent to develop/change/fix/verify a feature. Rework is a metric which assesses how much repeat time/effort was spent to complete a currently-open-and-active, or a previously-closed-and-reopened, feature/change/defect (Segue Technologies, 2014). The time of initial development work and the time of repeat work are clearly identified. Summation of both is the result of total work time.

Causes of rework:

Several avoidable and unavoidable reasons are responsible for rework. Some details can be minimized by seriously focusing on related works. Unavoidable causes that really impossible to ignore. Avoidable reason means those rework aims that can be easily controlled by stakeholders. Following are some spirited explanations.

1. The reason for rework is infrequently the result of individuals not doing their jobs well.
2. Improper planning
3. Poor communication
4. Inadequate testing
5. Unstructured programming
6. Poor logic and algorithm
7. Lack of domain knowledge
8. Insufficient time
9. Low-cost budget
10. One reason rework becomes necessary is that the development, design and engineering teams lack visibility into software requirements, which often change throughout the development process.
11. Poor requirements management can have a significant effect throughout the process and on the business itself. In fact requirements, defects account for 70 to 85 percent of rework costs. This is a very high cost.
12. Software errors found late in the development process can cost organizations up to 200 times more than if they were detected during the requirements analysis phase.
13. Late detection of bugs. That happens when teams don't pay enough attention to quality early in the development lifecycle error detection should not be left until the testing stage. According to the Carnegie Mellon Software Engineering Institute, "Data indicate that 60-80% of the cost of software development is in rework (IBM, 2009)."
14. The cost of rework can approach or exceed 50% of total project cost.
15. Rework cost rises dramatically the longer the delay relative to the life cycle, between the occurrence of a problem and its remediation. For example, for a problem that occurs in requirements analysis, the cost of repair may rise by one to two orders of magnitude depending on how late in the life cycle it is caught (Aaron G. Cass, 2017).
16. One incident where the cost of software rework was actually calculated. A bank totaled the cost of automated re-testing at $1 million to $1.5 million per month. This number doesn't even include the cost of manual testing, design time, meetings, coding, or unit testing (David McAllister, 2017).

Rework cost may fluctuate from organization to organization. Above history of rework cost is asking us why we do allow rework, why we do not reduce rework yet.

Risk level of rework: The risk level of rework differs over risk to risk, project to project. High-level risk of rework can lead to project failure. Risk management techniques would allow the project risk management team to identify, classify & prioritize the risk level, risky modules or components. In reality, it is very difficult to point out the risk level of rework in a large system. Rework become obligatory for a specific issue until the problem resolve. If the matter repeats several times and continuously works for the same matter, it not only waste time & money but also Damage Company good well. If the rework risk is too large for a firm to be willing to accept, the firm can avoid the risk by changing project strategies and tactics to choose a less risky alternate or may decide not to do the project at all. For example, if a project has a tight schedule constraint and includes state of the art technology.

Rework and reuse data of above projects: Data for this research were collected from small, medium and enterprise software firms. There are maximum local software development firms of Bangladesh & a few

international firms. This paper does not mention the firm's name, project & client's name in respect of the privacy policy. Software firms provided valuable data about their current and past projects. Many firms willingly told me that they had rework concerns but, they will try to overcome the disputes and they also agreed with me to develop reusable software components for their future projects.

Table 1: Rework and reuse data of above projects

		P001					P002					P003					P004					P005				
Sl.#	Components	Total Features	No of Rework	No of Reuse	Rework %	Reuse %	Total Features	No of Rework	No of Reuse	Rework %	Reuse %	Total Features	No of Rework	No of Reuse	Rework %	Reuse %	Total Features	No of Rework	No of Reuse	Rework %	Reuse %	Total Features	No of Rework	No of Reuse	Rework %	Reuse %
1	Planning	100	60	3	60.00	3.00	100	15	10	15.00	10.00	100	75	7	75.00	7.00	100	50	5	50.00	5.00	100	20	30	20.00	30.00
2	Concepts and domain knowledge	500	300	3	60.00	0.60	500	100	400	20.00	80.00	500	350	130	70.00	25.00	500	300	50	60.00	10.00	500	200	150	40.00	30.00
3	Source code	1000	900	300	90.00	30.00	1000	200	800	20.00	80.00	1000	700	300	70.00	30.00	1000	400	150	40.00	15.00	1000	550	250	55.00	25.00
4	Design and user interface	1000	800	400	80.00	40.00	1000	300	700	30.00	70.00	1000	200	400	20.00	40.00	1000	500	400	50.00	40.00	1000	250	450	25.00	40.00
5	Software architecture	500	200	4	40.00	0.80	500	50	400	10.00	80.00	500	450	4	90.00	0.80	500	300	100	60.00	20.00	500	300	100	60.00	20.00
6	Software requirement specifications	330	300	200	90.91	60.61	330	30	200	9.09	60.61	330	50	200	15.15	60.61	330	200	100	60.61	30.30	330	100	180	30.30	54.55
7	Design and user interface	1000	800	400	80.00	40.00	1000	150	400	15.00	40.00	1000	300	400	30.00	40.00	1000	500	400	50.00	40.00	1000	300	400	30.00	40.00
8	User manuals	100	70	10	70.00	10.00	100	25	70	25.00	70.00	100	70	10	70.00	10.00	100	70	20	70.00	20.00	100	70	25	70.00	25.00
9	Software documentation	200	150	5	75.00	2.50	200	60	150	30.00	75.00	200	15	5	7.50	2.50	200	35	15	17.50	7.50	200	80	30	40.00	15.00
10	Test case	300	160	0	53.33	0.00	300	12	250	4.00	83.33	300	200	0	66.67	0.00	300	200	50	66.67	16.67	300	200	100	66.67	33.33
11	Integration	200	50	0	25.00	0.00	200	5	150	2.50	75.00	200	180	0	90.00	0.00	200	120	30	60.00	15.00	200	150	20	75.00	10.00
12	Process	600	300	10	50.00	1.67	600	50	500	8.33	83.33	600	400	10	66.67	1.67	600	250	100	41.67	16.67	600	270	30	45.00	5.00
13	Database	800	700	4	87.50	0.50	800	75	700	9.38	87.50	800	500	100	62.50	12.50	800	100	600	12.50	75.00	800	300	500	37.50	62.50
14	Implementation & experience	400	200	1	50.00	0.25	400	20	200	5.00	50.00	400	200	1	50.00	0.25	400	160	140	40.00	35.00	400	200	150	50.00	37.50
15	Master setup data	700	400	10	57.14	1.43	700	50	600	7.14	85.71	700	400	10	57.14	1.43	700	300	400	42.86	57.14	700	350	200	50.00	28.57
16	Modules	300	100	20	33.33	6.67	300	80	200	26.67	66.67	300	250	20	83.33	6.67	300	180	120	60.00	40.00	300	200	120	66.67	40.00
17	Functions, procedure, package, plugins, Dynamic action, API	400	300	300	75.00	75.00	400	90	300	22.50	75.00	400	200	300	50.00	75.00	400	200	200	50.00	50.00	400	200	200	50.00	50.00
18	Queries, reports	250	150	200	60.00	80.00	250	10	200	4.00	80.00	250	100	200	40.00	80.00	250	100	150	40.00	60.00	250	100	50	40.00	20.00
19	Library	100	75	10	75.00	10.00	100	10	90	10.00	90.00	100	10	10	10.00	10.00	100	50	30	50.00	30.00	100	50	25	50.00	25.00
20	Algorithms	100	30	8	30.00	8.00	100	5	90	5.00	90.00	100	20	15	20.00	15.00	100	30	20	30.00	20.00	100	40	15	40.00	15.00
21	Models	150	25	15	16.67	10.00	150	15	100	10.00	66.67	150	15	10	10.00	6.67	150	70	20	46.67	13.33	150	15	10	10.00	6.67
22	Objects and text	350	30	20	8.57	5.71	350	0	250	0.00	71.43	350	150	25	42.86	7.14	350	250	25	71.43	7.14	350	100	25	54.29	7.14
23	Artifacts	220	15	2	6.82	0.91	220	0	200	0.00	90.91	220	200	2	90.91	0.91	220	75	25	34.09	11.36	220	120	60	54.55	27.27
24	Themes	250	35	30	14.00	12.00	250	1	200	0.40	80.00	250	155	40	62.00	16.00	250	200	40	80.00	16.00	250	140	40	56.00	16.00
25	Templates	100	45	40	45.00	40.00	100	1	90	1.00	90.00	100	50	40	50.00	40.00	100	50	40	50.00	40.00	100	50	40	50.00	40.00
26	Tools	50	5	5	10.00	10.00	50	1	50	2.00	100.00	50	1	5	2.00	10.00	50	25	5	50.00	10.00	50	20	5	40.00	10.00
	Grand Total	10000	6000	2000			10000	1355	7300			10000	5241	2244			10000	4715	3235			10000	4465	3155		

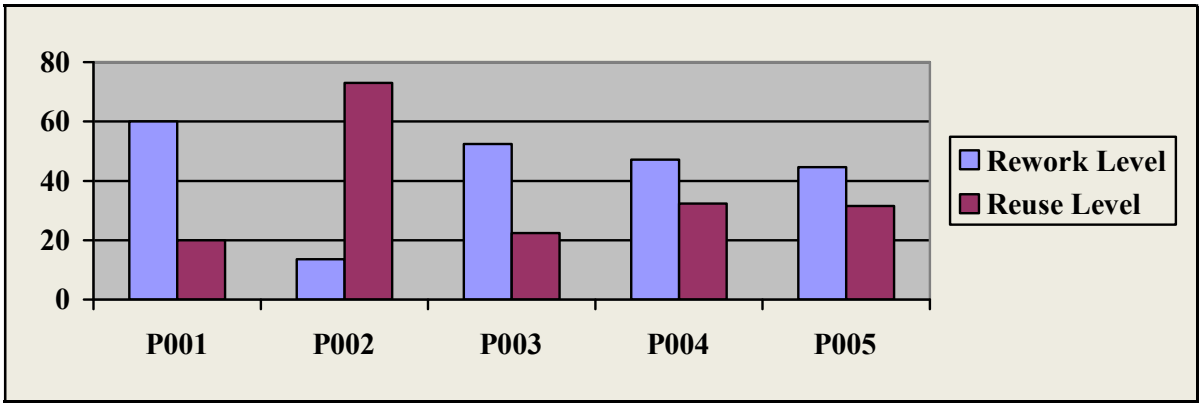

Figure 4: Rework and reuse summary of projects

Current rework & reuse level: Activity-based cost analysis helps to identify the current rework and reuse level. To figure out the percentage of present rework and reuse position, we used following formula for that calculation.

$$\text{Rework Level} = \frac{\text{Number of functionalities that needs rework (defect found)}}{\text{Total number of components in an application}} \text{ X } 100$$

$$\text{Reuse Level} = \frac{\text{Number of functionalities that reused from projects assets}}{\text{Total number of components in an application}} \text{X } 100$$

Current rework and reuse level of projects:

Table 5: Current rework and reuse level of projects

Project Code	Average Rework	Average Reuse	Current Rework Level	Current Reuse Level
P001	0.6	0.2	60%	20 %
P002	0.1355	0.73	13.55 %	73 %
P003	0.5241	0.2244	52.41 %	22.44 %
P004	0.4715	0.3235	47.15 %	32.35 %
P005	0.4465	0.3155	44. 65 %	31.55 %

Cost analysis for rework of the project P001:

Our enlisted P001 project will come in at a 60 percent rework rate:

Rework Cost = 0.60 * Project Dev Cost

Managing Software Requirements indicate that about half of all software defects are due to missing or bad requirements, but the cost of finding and fixing requirement defects is higher than that for other kinds of defects. In fact, they indicate that 70 to 85 percent of the rework cost is due to requirements defects. For our example, we could use 75 percent (or use own measurement):

Rework Cost of Requirements Defects = 0.75 * Rework Cost

Requirements defects range is higher. If the defect detects at an early stage then, the cost is lower but at production stage cost may be 100 or 1000 times higher. Following are the ratio of bug fixing in four stage.

- To fix a problem at the requirements stage costs is 1.
- To fix a problem at the development stage costs is 10.
- To fix a problem at the testing stage costs is 100
- To fix a problem at the production stage costs is 1000(Shahadat, 2018).

We estimate that the combined total objects of screens plus reports will be 300. Multiply by four person weeks to get twelve hundred person-weeks as

development effort. We now expect to have 1200 hundred defects at system test or user acceptance test. Estimate that half of those, fifty, will be due to requirements problems.

Now estimate rework cost at 60% of the initial development cost. Average wages paid $1,000 per person-week ($48,000 per year salary).

So the initial development cost will be 1200 PW * $1000 = $12,00,000.

Rework cost will add 60 percent to that:

Rework costs = 0.60 * $1200, 000= $720,000

Software development cost = initial development cost + rework cost

Total development cost = $12,00,000 + $7,20,000

Total development cost = $19,20,000

Next, you estimate the amount of rework that will be due to the requirements errors: 0.75 * $19,20,000= $14,40,000

Finally, you divide this rework cost by the number of requirements defects to determine the cost per requirement defect: $2,400 = $14,40,000/600 (1200/2 requirements defects).

Here one project P001 cost analysis has been described. Note that this is not total project cost or even your total development cost, it does not include project Management, QA time, analyst time, and so on. It only covers pure development effort and rework cost of a week. Cost analysis of the rest of the project is the same. Following table showing the calculation of cost of rework for above five projects.

Table -6 shows how the cost of rework is changing. Project P001 reworks percentage increased to 65%, simultaneously rewrite cost enlarged to $7,80,000 & total development cost increased to $1,980,000. Alternatively, if the rework fall to 55%, then rework cost fall to $6, 60,000, and total development cost falls to $1,860,000. This is just one variable effect on software economy. To complete this task quickly, if include another person then time will reduce to 5.6 days, but the development cost will increase to $3,200,000. Again, if remove one person to reduce the cost, then some cost will reduce, and the development cost will be $1,920,000, but time will increase to 9.33 days. Here total objects, number of man & salary are variable. Cost of development is varying with rising and falling off any of this variable values. Software companies want to reduce the rework.

Project Code	Rework %	Total Object	No of Man	Man Week	½ Req. Problem	Salary Weekly	Ini. Dev. Cost	Rework cost	Total Cost	Req. Cost 0.75	Per defect cost for req.
P001	60	300	4	1200	600	$1,000	$1,200,000	$720,000	$1,920,000	$1,440,000	$2,400
P002	13.55	400	4	1600	800	$1,000	$1,600,000	$216,800	$1,816,800	$1,362,600	$1,703
P003	52.41	200	3	600	300	$1,000	$600,000	$314,460	$914,460	$685,845	$2,286
P004	47.15	100	5	500	250	$1,000	$500,000	$235,750	$735,750	$551,813	$2,207
P005	44.65	500	5	2500	1250	$1,000	$2,500,000	$1,116,250	$3,616,250	$2,712,188	$2,170

Figure 6: Cost of rework

Now if the project P001 comes up with 20% reuse, then it's time will save 20% and the cost will save $240,000, and total development cost will be $960,000. The massive amount of cost is kept for reuse. I have successful records of cost & time saving by reusing one project objects to multiple projects and made a handsome profit. Here if comparison table 6 to table 7, the variation of development cost will be realized. Figure-7 shows the effect of reuse in the software economy. Here the percentage of reuse, total screen, number of men, salary are variables. Changes in this variable's value might change the cost of development.

For example, if P001 reuse, increase to 25% than its rate, reduce from $240,000 to $300,000 save for reuse is $60,000. Dramatically cost is falling by the rising of reuse. So Software companies must try to increase their reuse level.

Project Code	Reuse %	Total Screen	No of Man	Man Week	Salary Weekly	Initial Development Cost	Cost Save for Reuse	Total Cost
P001	20	300	4	1200	$1,000	$1,200,000	$240,000	$960,000
P002	73	400	4	1600	$1,000	$1,600,000	$1,168,000	$432,000
P003	22.44	200	3	600	$1,000	$600,000	$134,640	$465,360
P004	32.35	100	5	500	$1,000	$500,000	$161,750	$338,250
P005	31.55	500	5	2500	$1,000	$2,500,000	$788,750	$1,711,250

Figure 7: Cost save for reuse

Rework and reuse effects in software economy are opposite of each other's. If rework rises, then development cost rise, if rework fall, then development cost falls. Oppositely if reuse rises, then development cost fall, if reuse fall development cost rise. Both rework and reuse directly hit to cost. Rework rise cost rise, reuse rise cost fall. Target to upswing reuse & decrease rework. Bellow figure -8 shows that initial development cost exceed due to rework cost.

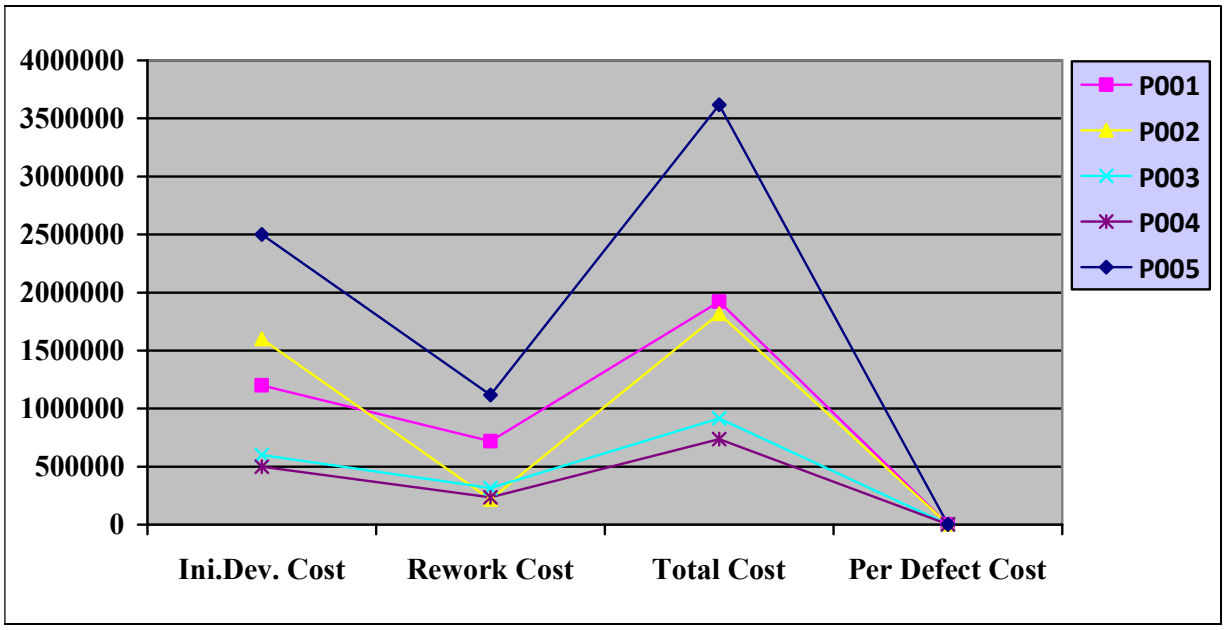

Figure 8: Cost of rework

In figure-9 we see total development cost exceed initial development cost for rework Cost. Total development cost becomes lower than the initial development cost for reuse. Development cost is falling and rising magically with increasing and decreasing of Rework and reuse charge. This figure shows that total development cost is bellow of initial development cost for reuse. Those projects have more reused its total Development cost is lower than the initial budget. Those projects have high rework its total development cost is higher than the original development charge. All project total development cost become higher than the opening development cost due to rework cost.

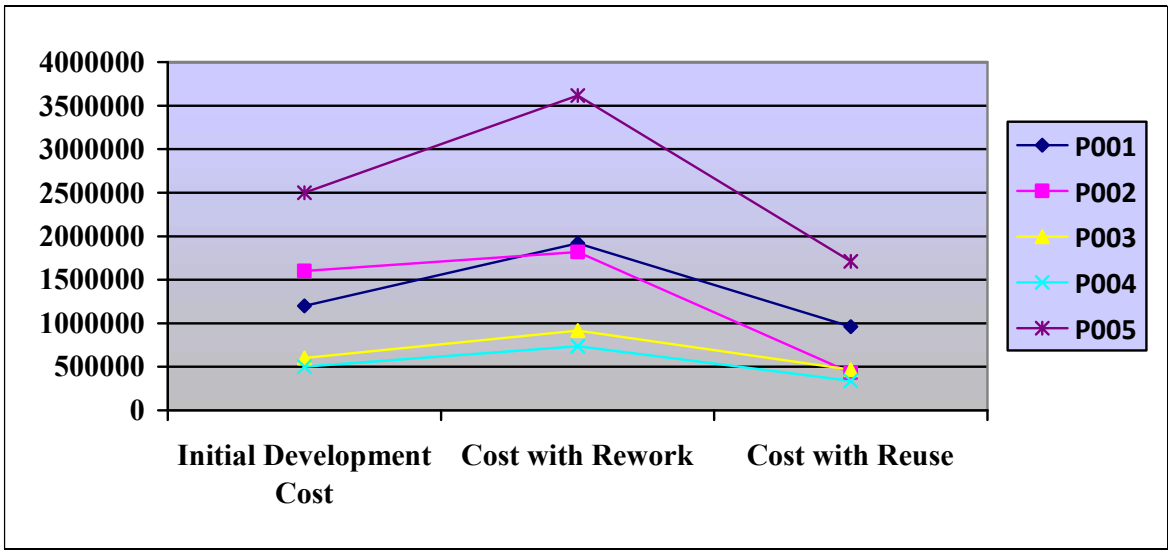

Figure 9: Rework cost and Reuse cost effect

Variation of cost: A project having 60% rework rate and 20% reuse rate frequently up and down of its development cost. Although the project development cost rise to the top than the initial development costs due to rework cost but it fluctuates with reuse effects. When the costs of development arises in this situation reuse is the best solution to reduce the cost. Figure-10 is explaining the combination effect of rework and reuse of a particular Project. Reuse is very effective, to reducing the development cost instantly, to the below than the initial development cost. Reuse avoids the vast amount of cost.

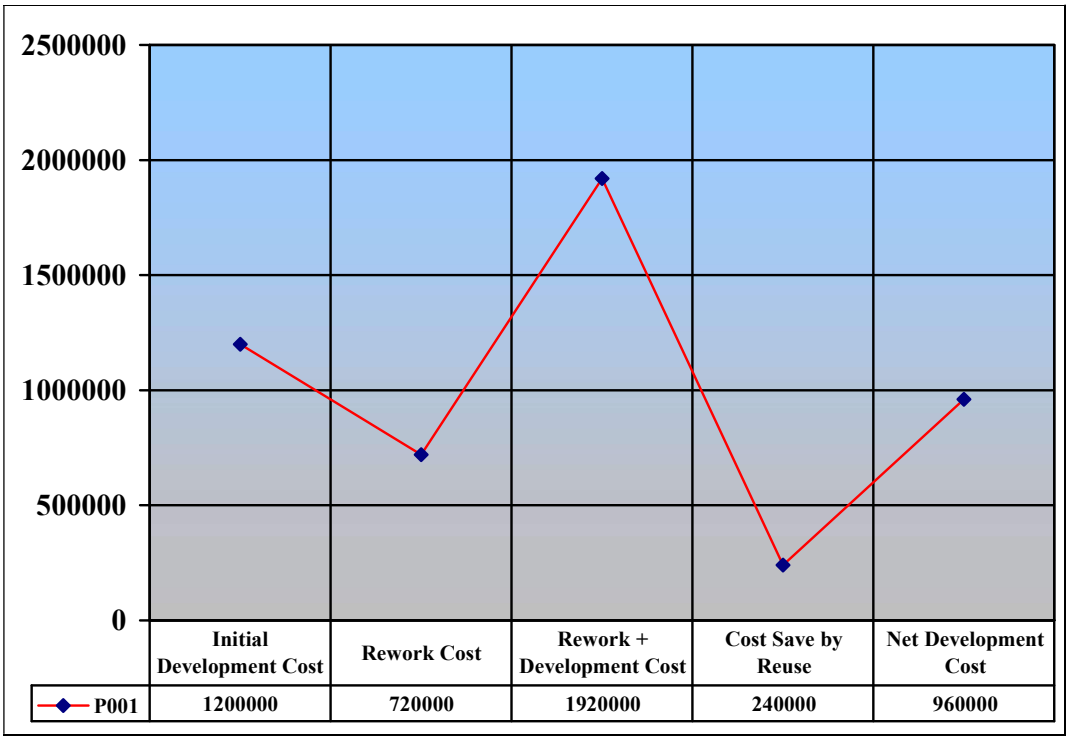

Figure 10: Up and down of a project cost for rework and reuse effect

How much cost saves from reuse of software: It is a vigorous question of the Software industry. The software company expects to save some cost by reuse. Because they are reusing some portion of a system and not developing the particular component from scratch. The amount of cost saving depends on the number of reusable components they used. There are several reasons for this discrepancy. The amount saved depends upon many factors. The most important factors are the following (Ronald J. Leach, 2011):

- The life cycle model used in the software development process.
- The development history of the software system of which the artifact is a substantial portion.
- The cost of beginning a policy of software reuse.
- The cost of creating and maintaining a reuse library of software artifacts.
- The percentage of the system that is made using existing software artifacts.
- The ratio of change in each software artifact that is being reused.
- Different levels of an organization have different goals for the reuse programs.

Figure-11 shows a project cost saving scenario from the reuse of previous software components, the extra cost paid for the rework and the difference between the original development budget & the net price of the development. How much cost will save from the reuse, will define by the management policy and planning.

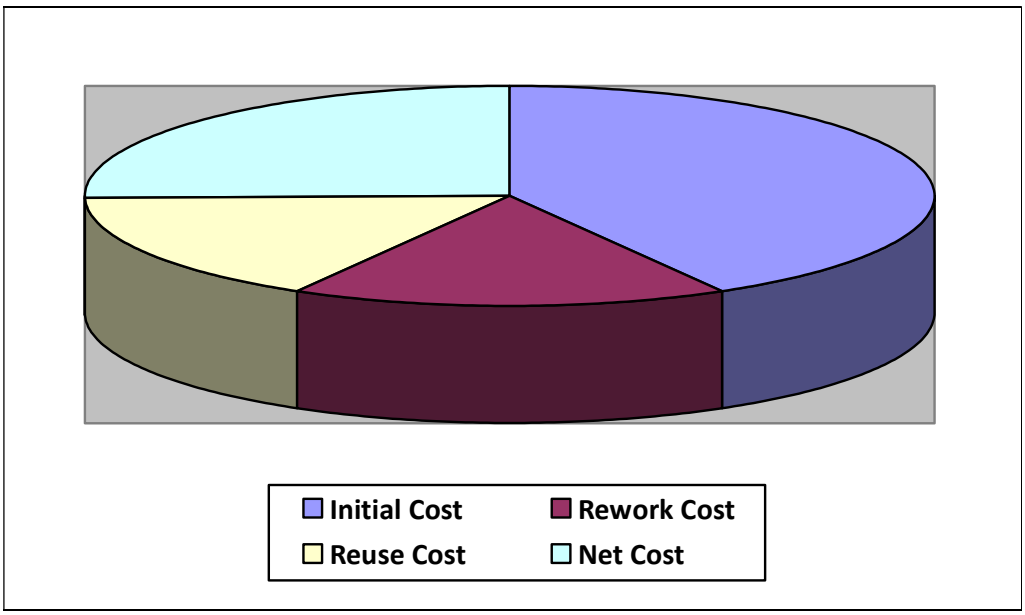

Figure 11: Cost saving from reuse of software

Time & cost effect: Time and cost is correlated with each other. Both are leading parameters of the project. Following example is more than enough to understand the time, and the cost effect on a project. An 8.7 kilometres Moghbazar-Mouchak flyover project was taken up in January 2011 and was supposed to be completed by December 2015. But, the authorities concerned went for a one-and-a-half-year time extension until mid-2017 with the construction still in progress. The construction cost of the flyover has increased to almost 72 percent as the construction agency was unable to complete the work in time and extended the project tenure several times. The authorities extended the deadline for completion three times, responding to the request from the builder. The construction costs has jumped to Taka 1327.4 crore from the original estimation of Taka 772 crore (Rick Haque, 2017).

Investment for reuse: Reuse is the robust components of the development process. First and foremost, we must recognize that reuse has the same cost and risk Characteristics as any financial investment (BH Barens, 1991). To get the benefit from software reuse, it is expected that the company should invest in the development of reusable software components. ROI of reusability depends on the efficient investment of reusable components. There are additional costs associated with understanding, Modifying, certifying, and maintaining it (Ronald J. Leach, 2011). It is clear that price is involved in the development of reusable software components as well as cost is involved in the uses of existing reusable software components. Barry Boehm explained the cost calculation as followed (Barry Boehm, 1997):

RCWR: Relative Cost of Writing for Reuse

$$RCWR = \frac{\text{The cost of developing reusable asset}}{\text{The cost of developing single-use asset}}$$

Investment for the development of reusable software component is calculated by the above formula.

RCR: Relative Cost of Reuse

$$RCR = \frac{\text{The Cost to reuse asset}}{\text{The cost to develop the asset from scratch}}$$

Investment of reuse of already developed existing reusable software component calculated by the above formula.

ROI of reuse: Return on investment for reuse is a widely used measure to compare the effectiveness of reusable components development investments. It is commonly used to justify software projects. The plain ROI calculation is to divide the net return from an investment by the cost of the investment and express this as a percentage. ROI, while a simple and extremely popular metric, it may be easily modified for different situations.

The ROI formula is:

$$\textbf{ROI } \% = \frac{\text{Return from reuse - Cost of Investment}}{\text{Cost of Investment}} \text{ X } 100$$

There is another term called ROR (rate of return), Rate of profit. The return is also known as money gained or lost on investment, profit or loss, gain or loss, net income or loss. The cost of investment is also known as investment, capital, principal, costs. A project is more likely to proceed if its ROI is higher because higher the better. For example, a 200% ROI over five years indicates a return of double the project Investment, over a five year period. Financially, it makes sense to choose projects with the highest ROI first, then those with lower ROI's. While there are exceptions, if a project has a negative ROI, it is questionable if it should be authorized to proceed.

Let's say a project P001 developed a reusable component in six month durations. P001 invested $6,000 for this reusable software component development. Later this reusable component was used in five projects. This reuse saved $24,000 development cost that is the return from reuse for the first year. So the ROI is

ROI = ($24,000 - $6,000)/$6,000 * 100

ROI = 300% for the first year

2nd years to 5th years the project will get return $30,000 per year if there is no exceptional investment require for this reusable component. The return will come four Times i.e.400% higher than investment continuously for the next four years. The ROI for the next four years will be ROI = 400%*4 =1,600%. A Net ROI of five years projects is 1,600% + 300%=1,900%. It is a successful investment for the development of reusable components and the successful reuse benefit. Here we see the return of reusable components is four times higher than the investment. The return increases 300% to 1900% within five years of project duration. That makes sense to decide for investment for reusable software components.

Reuse effect on software product line: It is essential to define the product line for produce new product by reusing an existing software product. Software product line architecture recycles standing product for productivity, quality, and profitability. Software product line practice carefully elicits, specify, analyze, and manage software requirements. This approach based on the systematic creation and reuse of existing assets in support of new product development (Emilio Insfran, 2014).

The Apple iOS is the best example of software reuse. When the original iPhone launched, the OS was called "iPhone OS", and it kept that name for four years, only changing to iOS with the release of iOS 4 in June of 2010. iOS is the name of the operating system that runs the iPhone, iPod touch, and iPad. It's the core software that comes loaded on all devices to allow them to run and support other apps. One year after the iPhone became a bigger hit than almost anyone projected, Apple released iOS 2.2.1. It was released on January 27, 2009 (then called iPhone OS 2.0) to coincide with the release of the iPhone 3G. The 1st generation iPad was

released in June 17, 2009, and version 3.2 of the software came with it. It added features including copy and paste, Spotlight search, MMS support in the Messages app, and the ability to record videos using the Camera app. Many aspects of the modern iOS began to take shape in iOS 4. Features that are now widely used debuted in various updates to this version, including FaceTime, multitasking, iBook's, organizing apps into folders, Personal Hotspot, AirPlay, and AirPrint. Another important change introduced with iOS 4 was the name "iOS" itself. iOS 4 It was released on July 25, 2011. iOS 5 was released on May 7, 2012 with wirelessness, and cloud computing features. A Controversy was one of the dominant themes of iOS 6 was released on Feb. 21, 2014. Like iOS 6, iOS 7 was met with substantial resistance upon its release on June 30, 2014. Unlike iOS 6, though, the cause of unhappiness among iOS 7 users wasn't that things didn't work. Rather, it was because things had changed. After the firing of Scott Forstall, iOS development was overseen by Jony Ive, Apple's head of design, who had previously only worked on hardware. In this version of the iOS, Ive ushered in a major overhaul of the user interface, designed to make it more modern. More consistent and stable operation returned to the iOS in version 8.0 was released on August. 13, 2015. iOS 9 was released on August. 25, 2016 with major improvements were delivered in speed and responsiveness, stability, and performance on older devices. iOS 10 was released on July 19, 2017. iOS 11 was released on May 29, 2018, contains lots of improvements for the iPhone, but its major focus is turning the iPad Pro series models into legitimate laptop replacements for some users.

Apple was continuously updating iOS and releasing one after one product by reusing the previous iOS. Apple becomes world's first trillion-dollar public company as on Thursday 2nd August, 2018. Apple Is Worth $1,000,000,000,000. Two decades ago, it was almost Bankrupt.

Microsoft is an unusual company for the sheer number of product lines. Microsoft has revolutionary reuse records since its start on November 10, 1983, to till now. Microsoft's bread and butter are Windows, the OS is doing quite well. Microsoft revealed that it had sold 400 million copies of its latest version, Windows 7. Microsoft's big sales pitch with Windows 10 is that it's one platform, with one consistent experience and one app store to get software from. There are seven different versions of Windows 10. Anyone who knows anything about Microsoft is aware of how essential its Office franchise is to the company. In every product, Microsoft reused the existing product, added new features and released a new product in the same product line.

Life cycle affected by rework & reuse: Software development life cycle different model are affected by rework & reuse. Such as waterfall model, spiral model, rapid prototyping model, agile model, etc. The cost saving from reuse can be started earlier in the life cycle model and can be realized at any phase (design phase, coding phase, test phase, etc.) of life cycle subsequent to the point at which the system is reused. When programmers took any component from the reusable library and used it as is without any change, then the element need not be tested because it was tested as a module earlier. Programmers only need to perform unit testing and integration testing in which the reusable component is engaged. No additional test cases, test plans or documentation need to write for this reusable component. At any segment of the life cycle if a bug is generated, or a scope for rework is produced, and it inherits to next part then its cost become several times higher than the earlier chapter. Early detection and prevention are cost-effective. If a scope of rework is formed in requirement specification phase, but it realized later in testing stage than the rework cost become higher than the requirement specification phase. The cost of rework varies from one phase to another phase of the software development life cycle.

Cost-benefit analysis of software reuse & rework: Rework is cost heads. Although rework has no financial benefit, but this research found a potential benefit of rework. Reworks help to find out the undiscovered bug, logical and exceptional issues. At some point of view, rework is re-check, re-testing of an existing system during next work. If an effort is done twice the result of the second labor is better than the result of first work. During the rework, some additional modification and the necessity to include new features may grow. The existing issues are cleaning by the Rework. Rework has some positive benefit. Rework cost is high, the cost vary from project to project. Reuse is revenue heads that save development time investment cost and improve quality. Figure- 12 is showing total cost and benefit of all project. Here particular cost heads didn't mention. Project to project the values of profit and loss may be varying. Some project may have a standard amount of turnover for remarkable reuse. Alternatively, project must count loss for oversize rework. Software reuse does not come free. We anticipate that developing reusable software on AAS will cost twice as much as developing nonreusable software. This alone could have deterred the AAS management from implementing a reuse program (Johan Margono, 1992).

Cost Benefit Analysis of Reuse and Rework

Costs

P001	720,000.00
P002	216,800.00
P003	314,460.00
P004	235,750.00
P005	1,116,250.00

Total Cost:	**2,603,260.00**

Benefits

P001	240,000.00
P002	1,168,000.00
P003	134,640.00
P004	161,750.00
P005	788,750.00

Total Benefit:	**2,493,140.00**

	Cost	**Benefit**	**Profit/ Loss**
Total:	**2,603,260.00**	**2,493,140.00**	**(110,120.00)**

Figure 12: Cost Benefit Analysis of reuse and rework

Anomaly Metrics Model for Software Rework Reduction: Majority of the reported anomalies belong to this category of real faults in the software or documentation delivered together with the software. Reproducible anomaly is an observed failure during testing that cannot be reproduced by the developer that is assigned to fix it. Getting many such failures might be due to the existence of many intermittent faults in the product. This indicates a robustness problem that probably requires improvements to the product architecture. Insufficient debugging environments are other common reasons for not being able to reproduce the failures. Anomalies occur when the requirements documentation is vague or incomplete. For example, when a test engineer, and a developer interpret a requirement differently, the tester is likely to submit an abnormality report. In these cases, the inconsistency report is defined as an opinion for function report which might also result in a correction. When an organization reports many anomalies of this type, it indicates that the requirements are not pure enough. (Lars-Ola Damm, 2008). According to Ola Damm above statement, it is important to cure all types of anomalies of every stage of SDLC whenever the anomalies introduce. It will reduce the rework otherwise in later stage rework will be increased and the rate of rework will also increase. The best way of anomalies & bug's rework reduction is killed it before born.

Prevention is better than a cure: This popular saying most definitely holds true when it comes to bugs or security issues identified within the SDLC. During the development process, it is more cost-effective and efficient to fix bugs in the early stages rather than later ones. The fee increases exponentially as the software moves forward in the SDLC. This research focuses on prevention the cure because prevention reduces rework that save time & cost of software development.

IV. Results

Bug fixing and rework are not the same things, but both are cost heads. Rework cost exceeds the project budget. Reuses saves both time and cost. This paper is influencing to reduce rework and increase reuse of software components to ensure the successive economic growth of Software Company. The prime goal of this project is to develop process assets that will be used to reduce rework & increase reuse levels of the software company. Here I didn't find any benefit for which Software Company can neglect to develop reusable components. This research found that rework

is harmful to the software economy. This research suggesting for early detection and prevention of bugs which is more cost-effective than testing & implementation phase.

V. Conclusion

This research found that economic growth of software companies falling for rework. All sizes of firms have more or less the rework problem. It is now one of the enormous challenges of the software industry. Rework is the barrier to the continuous achievement of financial improvement. This research focused on reuse to reduce the financial losses. The R2 is influential elements that move the economy. This paper is significant for modern software companies for high quality software development, as industries of all types utilize software applications to varying degrees. Unfortunately for startups, small businesses, and even multimillion dollar companies, tightening costs and rising competition mean a desperate scramble to find areas in which to slash expenses. Reduce your software development costs without sacrificing the quality of your product by following this paper cost saving strategy of reducing rework and increasing reuse.

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A New Landscape of Energy Efficiency: A Comprehensive Study on Various Electricity Consumption Related Smartphone Applications

By Md. Nahid Newaz & Md. Sohel Ahammed

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Abstract- With the recent emergence of mobile platforms capable of executing various complex software, there exists a variety of applications those provide services in the diverse field of interests. A public utility is one of the most interesting and demanding fields of interest in mobile platforms. In this article, we present a comprehensive study of various mobile applications that provide nudging for public utility, their acceptance, their pros and cons and other research aspects of those applications. In this article, we primarily focused on electricity consumption related to various public utility mobile applications. We present our findings based on mobile application's user ratings, number of installations and most importantly user feedbacks in terms of comments on those applications.

GJCST-C Classification: C.2.m

Strictly as per the compliance and regulations of:

A New Landscape of Energy Efficiency: A Comprehensive Study on Various Electricity Consumption Related Smartphone Applications

Md. Nahid Newaz [α] & Md. Sohel Ahammed [σ]

Abstract- With the recent emergence of mobile platforms capable of executing various complex software, there exists a variety of applications those provide services in the diverse field of interests. A public utility is one of the most interesting and demanding fields of interest in mobile platforms. In this article, we present a comprehensive study of various mobile applications that provide nudging for public utility, their acceptance, their pros and cons and other research aspects of those applications. In this article, we primarily focused on electricity consumption related to various public utility mobile applications. We present our findings based on mobile application's user ratings, number of installations and most importantly user feedbacks in terms of comments on those applications.

I. Introduction

Mobile applications are increasing tremendously especially during the last few years. As a result, there exists a large number of applications in roughly all fields of application. But all those applications did not provide great services to the people. There are various ways to know the acceptance of application via user ratings, user comments and number of times it is downloaded and installed. All those information provide us a great feedback about the acceptance of the application as well as its advantages and disadvantages from its real users. A public utility is an interesting and highly demandable field where mobile applications are being used increasingly. In our study, we presented a comprehensive study on the existing mobile applications for energy-related public utility, their acceptance analysis and finding and indicating their pros and cons. We finally present a comprehensive summary of various aspects of the findings of our study.

II. Related Work

There is various research works that provides a comprehensive study in various fields of application. But our study focuses on only mobile applications.

Dan Wang and Zheng Xiang present a comprehensive study on smartphone apps. In their study, they used data mining approach to classify types of information services and design features of travel-related i-phone apps as well as users reviews and evaluation for those apps. This study serves as an important foundation for understanding emerging mobile technology and will cause substantial changes in travel and tourism [1].

Mark Terry presents a study on medical apps for smartphones. In his study, he provides the features analysis, user acceptance and price analysis of those smartphone applications. He also provides a study on the companies that marketed those apps [2].

Martin F Mendiola, Miriam Kalnicki, and Sarah Lindenauer present a study on mobile health apps for patients and consumers. In their study, they analyze the content of the apps and their user ratings to identify the most valuable contents of those apps [3].

In our study, we will provide a comprehensive study on smartphone apps especially in energy efficiency and nudging related applications.

III. Categorization of Analysis Methods

Analyzing all types of smartphone apps related to energy efficiency and nudging we first categorize our analysis study into three categories based on three different dimensions of the dataset we have. Those three categories are an analysis of user's star ratings, analysis of a number of installations and analysis of user comments on those applications.

Word of mouth marketing is one of the most effective ways to sell a product or service. User star Ratings and Reviews provide this type of marketing online. Apptentive Consumer Survey 2015 provides the reason why star ratings and reviews are important [4].

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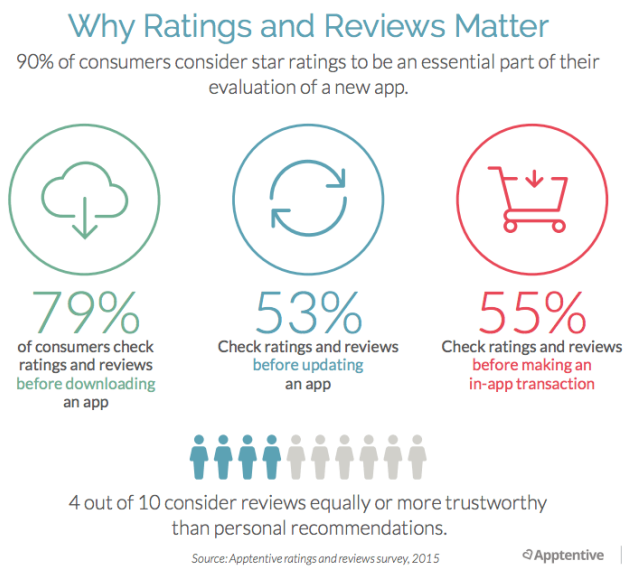

Figure 1: Importance of customer ratings and reviews based on Apptentive Survey 2015 [4].

Our study involved 25 electricity related mobile applications from various countries having various functional features and services. We analyzed 11,208 different users' star ratings, 3,400 different users' comments, and 697,760 application installations.

a) Analysis of User's Star Ratings

From small online businesses to e-commerce giants star rating systems are used in order to measure customer satisfaction and preferences. Now star rating systems are the cornerstone of recommendation systems in pretty much every web industry. Mobile applications industry is one of the large industry that uses star ratings for customer satisfaction and preferences. Apptentive Consumer Survey 2015 shows how star ratings affect application downloads [4].

Figure 2: Relationship between star ratings and number of downloads based on Apptentive Survey 2015 [4].

Our study shows that the average star ratings of electricity-related applications are 4.17-star which is pretty good as 96% users consider downloading an app with a 4-star rating.

Our study also finds that 56.09% users give 5-star ratings whereas only 14.20% users give 1-star rating to those electricity related applications.

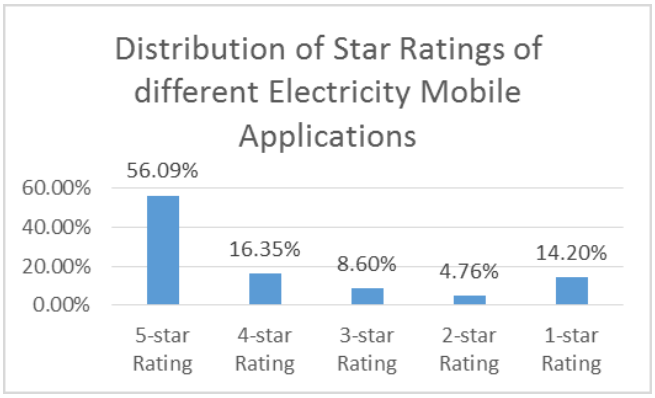

Figure 3: Distribution of Star Ratings between different electricity related mobile applications.

b) Analysis of Number of Application Installations

A number of downloads, download growth and update rates plays a great role in applications rank and promotions in app stores. Whenever a user installs an app in their device for the first time it is counted as a download and further updates do not contribute to the total downloads. So a number of installation roughly gives us the estimates about how many users are using and have used those mobile applications.

In our study, we found that the average number of installation of various electricity-related applications is 29,073. This means every electricity related application has on an average 30 thousand users.

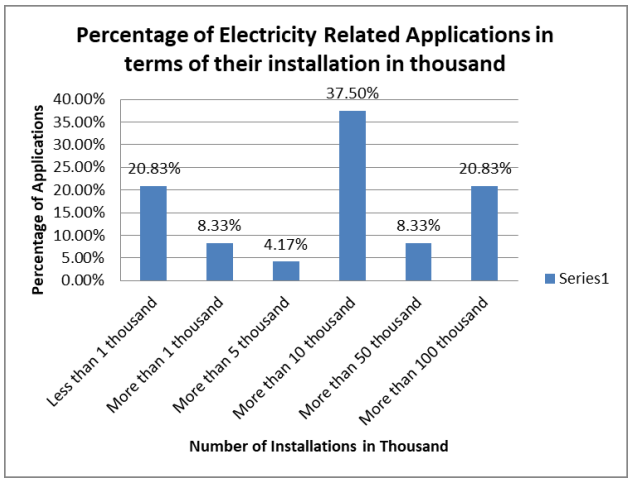

Figure 4: Percentage graph of electricity-related applications in terms of their number of installations.

In our study, we found that 20.83% of electricity-related applications are installed in less than 1 thousands times. 33% of electricity-related applications are installed in less.

Than 10 thousand times whereas 67% of electricity-related applications are installed in more than 10 thousands times. This clearly indicates that the uses of electricity-related utility software are very high and the number of highly ranked electricity related applications is also huge.

c) Analysis of User Comments

Online reviews are crucial to any mobile application that wants to keep control of its online reputation. Online reviews have created a new form of marketing and communication. Though customer reviews range in thoroughness and comprehensibility, they do hold a powerful effect on the behavior of other audience and therefore, the performance of the application. According to the survey by Bright Local 85% of consumers trust online reviews as much as personal recommendations [5]. Reviews can also help us to find out what works and what does not work and where to focus in our development efforts.

Apptentive shows in their survey done in 2015 that why users leave reviews. According to their survey 73% of users review an app after a negative customer experience, 60% users review an app after positive customer experience, 39% review an app to file a bug report, 24% review an app to suggest a feature and 16% review an app to comment on a version update [4].

In our study, we categorized our customer reviews into three categories.

Category Name	Comments Type
Negative	Rude Suggestion /Problems/Criticism
Positive	Appreciation/Praise/Soft suggestion
Neutral	Questions/Inquiry

The distribution of comments on those three categories are given below

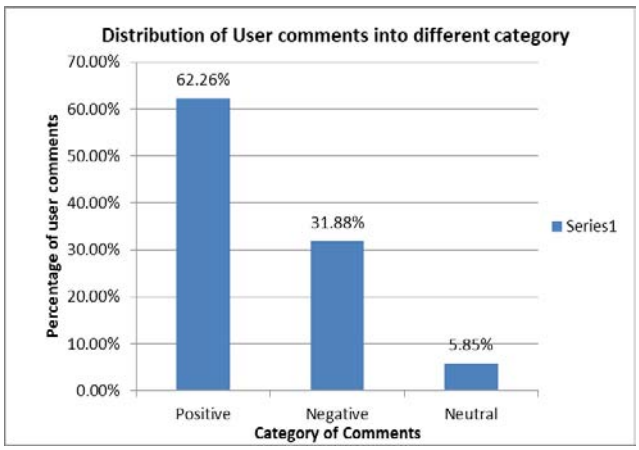

Figure 5: Distribution of user comments in the different category.

In our study we found that 62.26% of user comments on electricity-related mobile applications are positive, 31.88% are negative and only 5.85% are neutral. This clearly indicates that people found those applications helpful and trusty.

Among those 62.26% positive comments we found that most of the comments appreciated and praise the applications such as an excellent app, Nice work, helpful app etc.

And among those 31.88% negative comments we found that most of the problems are update related problems such as updates does not work, electricity price rates are not updated ones, update version crashes etc. Another most frequent negative comment is an interface and features related problems such as bad design, features need to be added, some features do not work etc.

IV. Discussions and Findings

After analyzing those electricity related smartphone apps we found some interesting findings that can help future application development in this field and update the existing related applications so that they can satisfy the app users. Our findings are given below:

a) Users are interested in electricity Related Mobile Applications

We found that current users are very much interested in reducing their electricity consumption and make use of mobile applications to help them for this reduction. The average number of installation of electricity-related applications is 30 thousand which clearly prove our statement.

b) The quality of existing electricity related mobile applications are very good

We found that the quality of existing electricity related mobile application is very good. The average ratings of all electricity-related mobile applications are 4.17. AS according to Apptentive survey 96% users want to download an app if its rating is 4, the rating of electricity-related applications is praiseworthy.

c) Users Participate Positively in Reviewing Electricity Related Mobile Applications

We found that number of comments on electricity-related applications that gives positive responses is significantly greater than those which gives negative responses. We found that approximately 62.26% of user comments were positive. So this clearly supports our findings

d) Most of the problems of current electricity related applications are caused by lack of updates and poor user interfaces

When we analyzed the applications negative reviews we found that approximately 40-45% negative reviews were somehow related to application update problems and poor interface design issues. So this clearly suggests that our future applications should solve those issues seriously.

V. Conclusion

From the above discussions and findings, we can conclude that people are now very much interested to make use of different Smartphone applications to reduce and monitoring their energy uses. An outstanding mobile application in this field can not only help us in reducing electricity consumption but also can save our valuable money. Production of electricity often causes some negative environmental impacts. Reduction of electricity consumption using those mobile applications can help us in these environmental issues. But our existing electricity related mobile applications have some problems and we need to do some effective research to improve their services. So, in future we need great apps in this sector that can really help us to change our behavior or habits that can reduce energy, save money and make the world greener.

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

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Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

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Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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