Expenditure Management System (EMS) using Single Board Computer (SBC)

by

OJO RASHEED
(1432321233)

A thesis submitted in fulfillment of the requirements for the degree of Master of Science (Embedded System Engineering)

SCHOOL OF COMPUTER AND COMMUNICATION ENGINEERING
UNIVERSITI MALAYSIA PERLIS

2014 -2015

ACKNOWLEDGEMENT

In the name of greatest All mighty ALLAH. Alhamdulillah, all praises to Allah for the strengths who has always bless me with potential knowledge and opportunity to write this project. I offer my thanks and profound gratitude to my supervisor Professor Dr. R. Badlishah Ahmad who supported me with his experience and knowledge which has opened new vistas to me in Embedded System Engineering.

I am extremely grateful to my co-supervisor Mr. MD. Mostafijur Rahman for his sustained enthusiasm, patience, suggestions, motivation and guidance throughout the course of my research.

I would like to thanks my caring, loving, and supportive wife, Halimo: my deepest gratitude. Because she maintains a continued study and care for our children. Your encouragement when the times got rough are much appreciated and duly noted. It was a great comfort and relief to know that you were willing to provide management of our household activities while I completed my work. My heartfelt thanks.

My appreciations go to all the people who have supported me in completing this research.

Finally, I would like to thank my family to whom I owe a great deal. To my late father and mother, May there soul rest in perfect peace for showing me that the key to life. I would like to give my sincere respect and appreciation for my brother Nurudeen, for their kindness and moral support during my study.

OJO RASHEED

UNIVERSITY MALAYSIA PERLIS (UniMAP)

ojorasheed@gmail.com

TABLE OF CONTENTS

		PAGE
DECLARATION OF THESIS		**i**
ACKNOWLEDGEMENT		**ii**
TABLE OF CONTENT		**iii**
LIST OF TABLES		**vii**
LIST OF FIGURES		**viii**
LIST OF ABBREVIATIONS		**xi**
ABSTRAK		**xii**
ABSTRACT		**xiii**
CHAPTER 1	**INTRODUCTION**	
1.1	Overview	1
1.2	Problem Statement and Motivation	1
1.3	Research Aim and Objectives	2
1.4	Research Scope	3
1.5	Organization of Thesis	3
CHAPTER 2	**LITERATURE REVIEW**	**4**
2.1	Home Expenditure Management System	4

2.2	Generic way to track home expenditure	4
2.3	Framework of Expenditure Management System Linkages	5
2.4	Existing Research on Expenditure Management System	8
2.4.1	Expense Management	8
2.4.2	The Medium Term Expenditure Management System Approach	10
2.4.3	Financial Management Information System (FMIS)	12
2.4.4	Cash Management System	12
2.5	Embedded System	13
2.5.1	Single Board Computer (SBC)	16
2.5.2	Embedded Operating System (OS)	18
2.5.3	Embedded Linux	19
2.6	Web Development tools	20
2.6.1	Dreamweaver	20
2.6.2	Personal Home Page	21
2.6.3	MySQL	21
2.7	DC Motors	23
2.8	Summary	25
CHAPTER 3	**RESEARCH METHODOLOGY**	**26**
3.1	Overview	26
3.2	Hardware design of EMS	26
3.3	TS-7800 Board	29
3.4	TS-7800 Hardware Description	29
3.4.1	Flowchart of EMS	30

3.4.2 Functionality of DIO headers 33

3.4.3 TS-7800 Software Description 34

3.5 Software Design of phpMyAdmin and MySQL 35

3.5.1 MySQL Database 37

3.6 Design of SHEMS Application Modules 39

3.6.1 Initialize Module (IM) 42

3.6.2 Analysis Module (AM) 44

3.6.3 DC Motor Speed Control 46

3.6.4 Monitoring Module (MM) 46

3.7 Summary 47

CHAPTER 4 RESULTS AND DISCUSSION 48

4.1 Overview 48

4.2 Hardware Prototype Design for web based EMS 48

4.3 Experimental setup 51

4.4 CPU Utilization 53

4.5 Memory Utilization 55

4.5.1 Hardware Performance 56

4.6 Software Output Results 57

4.7 Summary 70

CHAPTER 5 CONCLUSION AND RECOMMENDATIONS FOR FUTURE WORK **71**

5.1 Overview 71

5.2 Future Work 72

5.3 Research Contributions 72

REFERENCES **73**

APPENDICES **77**

Appendix A 77

Appendix B 80

LIST OF TABLES

NO.		PAGE
2.1	Specifications of various SBCs types	15
2.2	Components and Description of some SBC types	17
3.1	Functionality of DIO Headers	29
4.1	CPU Utilization for TS-7800	53

LIST OF FIGURES

NO.		PAGE
2.1	Framework Showing EMS Linkage	6
2.2	Provincial Development planning and EMS	7
2.3	Expense Management Software	9
2.4	Expense Management Software Feature	10
2.5	Dreamweaver	20
2.6	PHP	21
2.7	MySQL	23
3.1	EMS menu screen template	27
3.2	EMS menu cash box structures	28
3.3	TS-7800 Hardware Description	30
3.4	Flowchart of EMS	32
3.5	PhpMyAdmin home	36
3.6	MySQL Database	37
3.7	EMS Application Modules Flowchart	40
3.8	Architecture Design Code	41

3.9	Initialize Module	42
3.10	C code to initialize DIO on TS7800 SBC	43
3.11	Analysis Module	45
3.12	Monitoring Module	47
4.1	Prototype Design for EMS	50
4.2	Experimental setup	52
4.3	CPU Usage	54
4.4	Memory Usage	56
4.5	EMS information home page	57
4.6	EMS deposit Webpage	58
4.7	EMS Withdraw Table Information Webpage	59
4.8	EMS Withdraw Webpage	60
4.9	EMS showall Webpage	61
4.10	EMS deposit table Webpage	62
4.11	EMS daily Webpage	63
4.12	EMS guest Webpage	64
4.13	EMS Child Webpage	65

4.14	EMS Medication Webpage	66
4.15	EMS Vehicle Webpage	67
4.16	EMS Bill Payment Webpage	68
4.17	EMS Other Webpage	69

LIST OF ABBREVIATIONS

EMS	Expenditure Management System
SBC	Single Board Computer
TS	Technologic Systems
TS-Linux	Technologic Systems Linux
ES	Embedded System
IM	Initialize Module
CPU	Central Processing Unit
AM	Analysis Module
DIO	Data Input Output
GPIO	General-purpose input/output
MM	Monitoring Module
PC	Personal Computer
PHP	Personal Home Page
RAM	Random Access Memory
SQL	Structured Query Language

Sistem Pengurusan Perbelanjaan (EMS) menggunakan Lembaga Single Komputer (SBC)

ABSTRAK

Sistem Pengurusan Perbelanjaan Rumah (HEMS) endows dengan rangka kerja perbelanjaan untuk keluarga untuk membangun dan melaksanakan pelan perbelanjaan pintar. Ia juga menyediakan satu petunjuk yang kemas untuk memperuntukkan wang untuk menetapkan keutamaan untuk pelan kewangan dan bajet. Sehingga sistem pengurusan perbelanjaan jenis ini yang terdapat di pasaran. Semua tumpuan mereka adalah untuk mendapatkan akaun perbelanjaan tepat pada masanya. Perbezaan datang kepada ciri-ciri mereka, sama ada perisian dan / atau pembangunan perkakasan. Pembangunan EMS boleh sama ada sepenuhnya perisian berasaskan dan / atau perkakasan berasaskan. Untuk pengurusan perkakasan dan berasaskan web perbelanjaan rumah ciri pemantauan maklumat yang mana kajian ini dicapai penting dari penyelidikan yang sedia ada. Dalam perkembangan perkakasan Lembaga Komputer Single (SBC) digunakan sebagai unit kawalan dan boleh diakses melalui mana-mana rangkaian berasaskan Ethernet / tanpa wayar. HEMS berkesan juga membolehkan keluarga daripada kegunaan yang kurang penting kepada yang lebih bernilai apabila keperluan dan keutamaan perubahan tanpa perkakasan. Modul perisian tinggal di SBC untuk memantau perbelanjaan rumah sistem pengurusan maklumat semasa dan bersejarah. Kajian ini menerangkan EMS Sistem Pengurusan dipanggil Perbelanjaan (EMS) reka bentuk dan pelaksanaan. EMS mengandungi tiga modul. Modul Permulaan (IM), memulakan semua modul tahap kernel dan pengguna perlu; Modul Analisis (AM), menganalisis data input sama ada mengeluarkan jumlah ada atau untuk mencari apa-apa kesilapan pangkalan data, dan kemudian menyimpan data ke dalam pangkalan data yang terkandung di dalam SBC. Modul Pemantauan (MM) adalah aplikasi berasaskan web di mana pengguna dapat meneroka status data perbelanjaan melalui mana-mana pelayar web. Eksperimen ini menunjukkan bahawa sistem EMS yang amat serupa (kurang daripada 0.5% perubahan) Keputusan menunjukkan bahawa memori dan CPU kadar penggunaan 2.4%; oleh EMS adalah tepat semasa pelaksanaan pada SBC tanpa mengira CPU yang rendah pada kadar 8.7% dan 7.8% masing-masing kelajuan dan saiz ingatan.

Expenditure Management System (EMS) using Single Board Computer (SBC)

ABSTRACT

The Home Expenditure Management System (HEMS) endows with an expense framework for a family for developing and implementing a smart expenditure plan. It also provides a neat indication to allocate monies for setting priorities for the financial and budget plan. Till now different types expenditure management systems available in the market. All of their focus is to get timely expenditure accounts. Differentiations come on their features, either in software and/or hardware development. The development of EMS can be either fully software based and/or Hardware based. For hardware management and web-based home expenditure information monitoring features for which this research achieved significance from existing research. In hardware development a Single Board Computer (SBC) is used as a control unit and accessible via any Ethernet/wireless based network. Effective HEMS also enable the family from less-valued uses to more-valued ones when needs and priorities change without hardware. The software modules reside in the SBC for monitoring current and historic home expenditure management systems information. This research describes EMS called Expenditure Management System (EMS) design and implementation. EMS consists three modules. The Initial Module (IM), initiate all kernel and user level necessary modules; the Analysis Module (AM), analyze the input data either the withdraw amount is available or to find any database error, and then save data into embedded database inside SBC. The Monitoring Module (MM) is a web based application by which user able to explore expenditure data status through any web browser. The experimental shows that the EMS system is very much identical (less than 0.5% variation) results show that the memory and CPU usage rate is 2.4%; by EMS is exactly during execution on SBC regardless of its low CPU at 8.7% and 7.8% respectively speed and memory size.

CHAPTER 1

INTRODUCTION

1.1 Overview

Home Expenditure Management System (HEMS) provides a framework in the house for developing and implementing expenditure plans and it furnishes the evidence needed to allocate monies to key priorities through the fiscal and budget processes. Home expenditure management systems to prevent fraud and prove fact of being complaint with supervise by means of rules and regulation need. Smart Home Expenditure Management System is most important enough to merit attention for family members with the number of children in the home, it seems that the advantages of new HEMS will impact on the future home life as well as greatly increase near future since the future home appears to be a new knowledge for concerned with applied by introducing new idea nowadays (Pradhan, S., 2009). On the other hand, people try to find suitable techniques from among new techniques to handling cash for withdrawal and deposit.

1.2 Problem Statement and Motivation

Since the HEMS is very much identical gives a totally different flexibility and functionality, the implementation and the enhancement of effective system for managing these expenses. The access is prerequisite for the most favorable utilization to manage the limit of number note wisely, and get maximum value for the money deposit or withdraw (Schick, A., 2011). Provides the following HEMS is having the right amount of money in the right place and time to meet the people obligations in the most cost-effective way. From existing HEMS is often difficult, protected as they are by inertia, past commitments, and vested interests. Expenditure management

System (EMS) focuses on outcomes of a budget. It explores the expenditures to produce outputs which are needed to achieve desired outcomes. The development of EMS can be either fully software based and/or Hardware based. There are some software based EMS available (B. Schulz, 2009). In the market, which are cost-effective and commercialized in the sense of their source code unavailability. The software based EMS may need proper installation environment. To overcome the installation, developers have develop web-based EMS, which only be accessed once the registration is completed and cost-effective too. Thus an EMS device is necessary to run as a plug & play device (Rezaian, B., 2010). Incorporated these concepts and explore possible synergies and trade-offs among them. It is also feasible and useful to review the system periodically and assess how efficient, effective, and relevant they are. Effective HEMS also enable the family from less-valued uses to more-valued ones when needs and priorities change without hardware. To do this, for EMS on Single Board Computer (SBC). Is going to provide more less-value for the home family needs and easy to withdraw less than ten ringgit note by using the capacity of both software and hardware compare with existing system from spending initiatives.

1.3 Research Aim and Objectives

Aim of this project is to design an Expenditure Management System using Single Board Computer (SBC). The main objective of this project is to achieve the reasons underlining the design of EMS by using Single Board Computer (SBC.).

The specific objectives are to:

i. To analyze and investigate the existing Home Expenditure Management System software.

ii. To design an Expenditure Management System hardware using Single Board Computer (SBC).

iii. To analyze the performance and feature of the propose design.

1.4 Research Scope

This research present a technical design of a smart home expenditure management system using Single Board Computer (SBC). The EMS should design and investigate evolve to take advantage of technological innovations. SBC consists of many I/O interfaces to build complete system with all peripheral devices needed and important role in the successful use of the system. This would cause the home users to spend less time using the machines and to carry out more efficient withdrawal less than ten ringgit note.

1.5 Organization of Thesis

The rest of the chapters organized as follows. The Literature Reviewed chapter introduces the basic on HEMS and investigates the existing HEMS to fulfill one of the objectives. The Methodology chapter describes the proposed EMS design technically. The Result and Discussion chapter describes the results and evaluates the performance of the proposed EMS. Finally the Conclusion chapter concludes the overall research with future direction.

CHAPTER 2

LITERATURE REVIEW

2.1 Home Expenditure Management System (HEMS)

Home expenditure management system provide the control and reporting income entries which occur each every day defined as facilities that will ensure home compliance, and make quantifiable savings on expenditure spend (Campos, & Pradhan , 2009). HEMS can be defined as Home Finance Management System (HFMS). In this family expenditure management system that logged information which are saved into a buffer / database. The buffer is used to keep transaction information temporarily. On the other hand, database is used as a permanent storage.

2.2 Generic Way to Track Home Expenditure

Most petty cash home expenditure purpose occurring as a minor part which support homes. The owner needs some cash for daily market, and needs cash for cleaning supplies or light bulbs. To track home expenditure user need to have the password for kept securely in a locked petty cash home that is used for small, miscellaneous expenditures.

For existing products, intention-behavior conversion rates can be obtained from past time periods (Rubin, 2008). This method should lead to successful in reaching the intended target sales forecasts if these conversion rates are stationary over time. While this thesis deals with existing future products, there is an analogy to new product estimate especially of the weather. For new products, intent-behavior conversion rates can come from past process closely observing of similar products or from established industry norms (Stallmanna, 2010). Describe a set of

different intent-behavior conversion norms that have been used by industry practitioners. The accuracy of this method for new product forecasting will depend on the extent to which intent-behavior conversion rates vary across similar products. Not completely confident about the best way to use intentions, one strategy is to use different approaches to develop forecasts, then to combine the forecasts from these they start to deal with in a certain way.

Feature products at the most appropriate cost with strong marketing interested will make certain of strongly desiring to be more successful than others.

i. Product marketing and Product features, design and distinctive attribute can all be smart to require target market. So too can its image and the customer service provide.
ii. Product positioning need to focus on quality, able to be relied on and customer service to arrange product as a premium offering that's better than the interaction between. Usually more existing product for particular customers will also seem unique.
iii. New existing product development need to ensure a sensible and reliable flow of new products.

2.3 Framework of Expenditure Management System Linkages

A simple framework showing the expenditure management system linkages among the four processes covered by the guidelines is presented (Campos, J.E. 2009). In Figure 2.1:

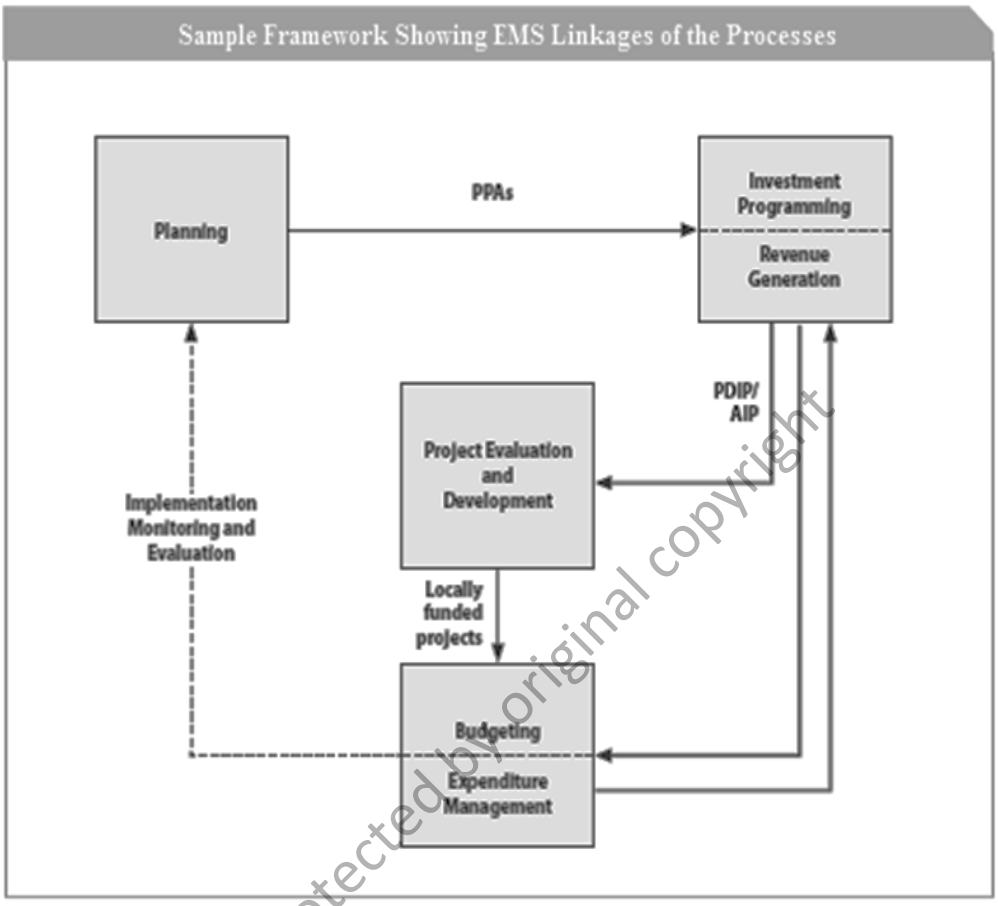

Figure 2.1: Framework Showing EMS Linkage

It is important to note at the outset that the EMS linkages shown are ideal and be entitled the main relationships among the processes. In some cases, there are nuances of actual practice that are not reflected in Figure 2.1. In reality, project evaluation and development between all the processes outlined. For instance, important PPAs may experience evaluation and development even existing to the investment programming process.

(Pradhan, S. 2009) Figure 2.2: is a logical structure of the simple framework of the EMS linkages of the processes in Figure 1, and emphasizes the linkages of the final outputs of the principle. More importantly, it places such outputs in the context of an overall provincial development planning and expenditure management system, and of the hierarchy of plans and investment programs.

A number of important relationships and EMS linkages shown in Figure 2.2:

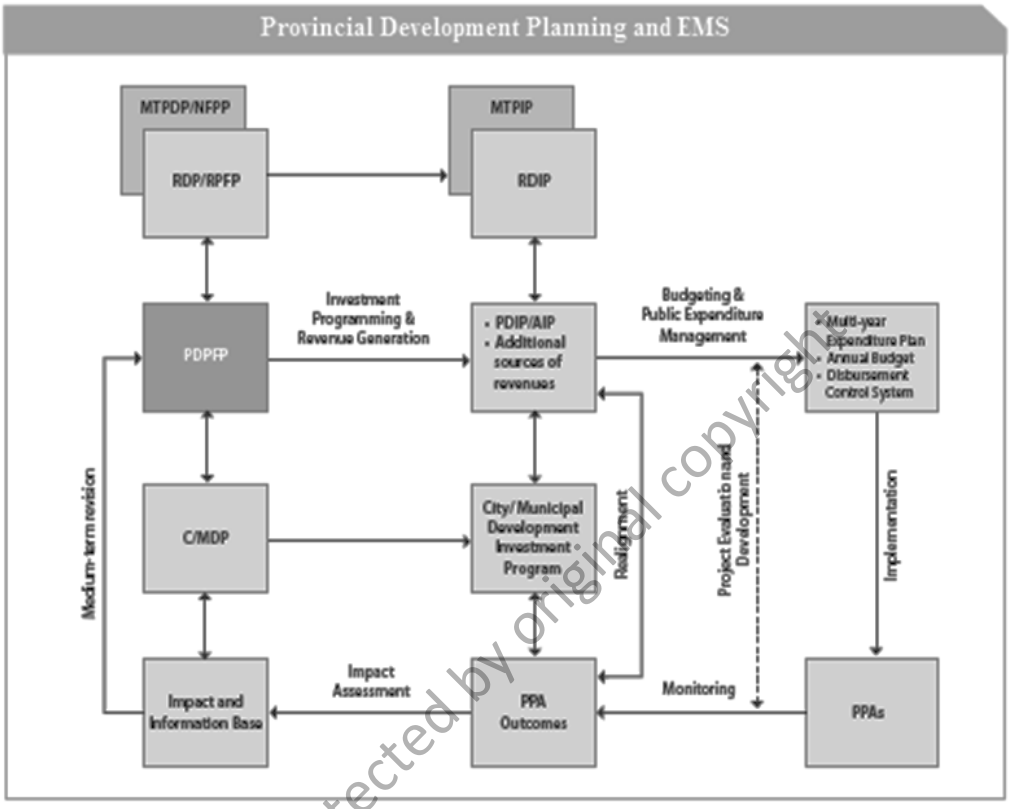

Figure 2.2: Provincial Development Planning and EMS

2.4 Existing Research on Expenditure Management System

There are many commercial and non-commercial research going on for expenditure management (EM). It can be combined with either software / hardware or both. Expenditure Management Software is to manage the required claim, authorization, audit and repayment processes can be obtained from organizations that provide a licensed software, implementation and support service, alternatively (Hopelain, D.G. 2011).

2.4.1 Expense Management

EM this means in which an organization can significantly reduce transaction costs and improve management control when logging, calculating and processing corporate expenses (Heidenhof, 2010). Independent research evaluating the use of automated expense management systems has confirmed that the cost of processing an expense claim is reduced as the level of automation increases show in Figure 2.3.

EMS Features is an important process for any business, big or small. Yet, very few on the executive level think to consider the money and time lost by using Excel or other spreadsheets and systems to complete expense reports the old-fashioned way (Premchand, A. 2012). Key features to keep in mind for expenditure management software features include:

- Mobile technology
- Policy integrations
- Trend analysis capabilities
- Easy implementation

Figure 2.3 shows an existing expenditure management software which can create work orders and bills of materials.

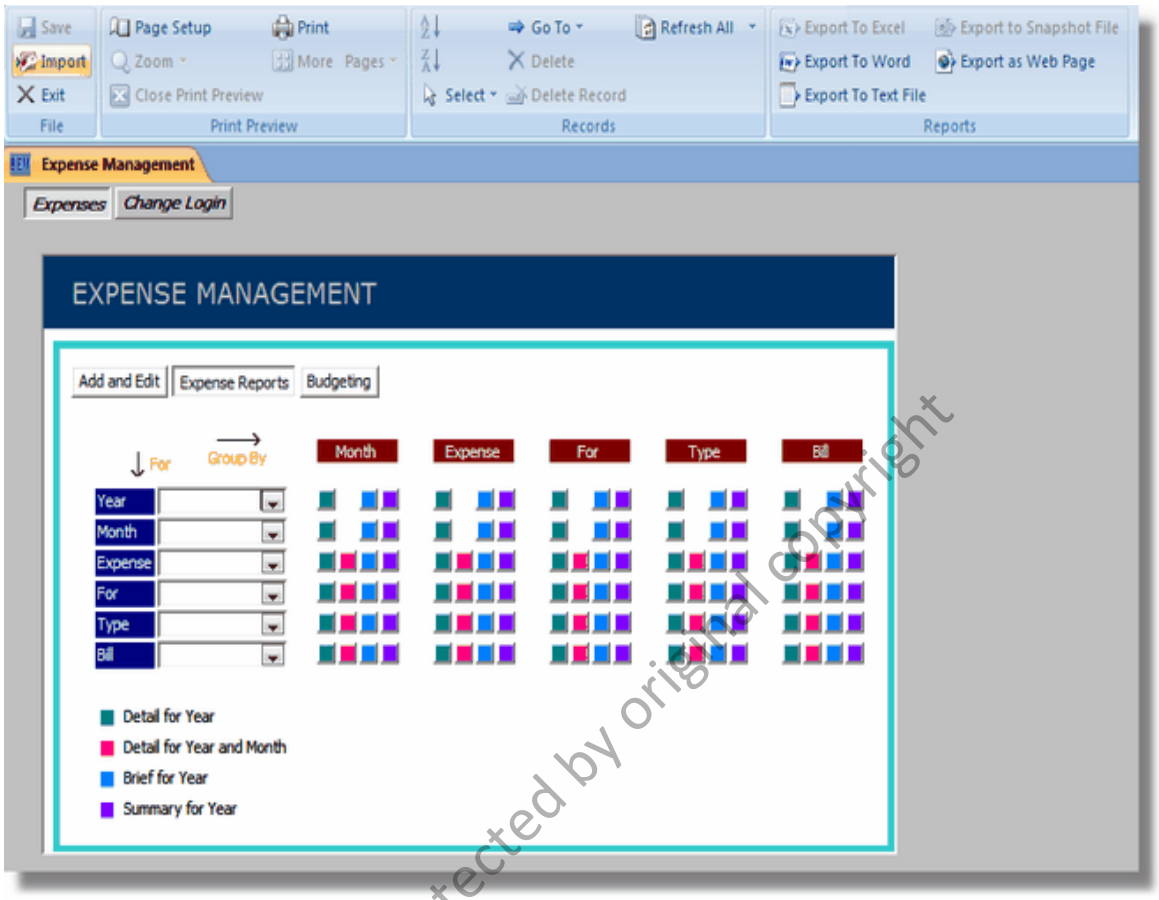

Figure 2.3: Expense Management Software

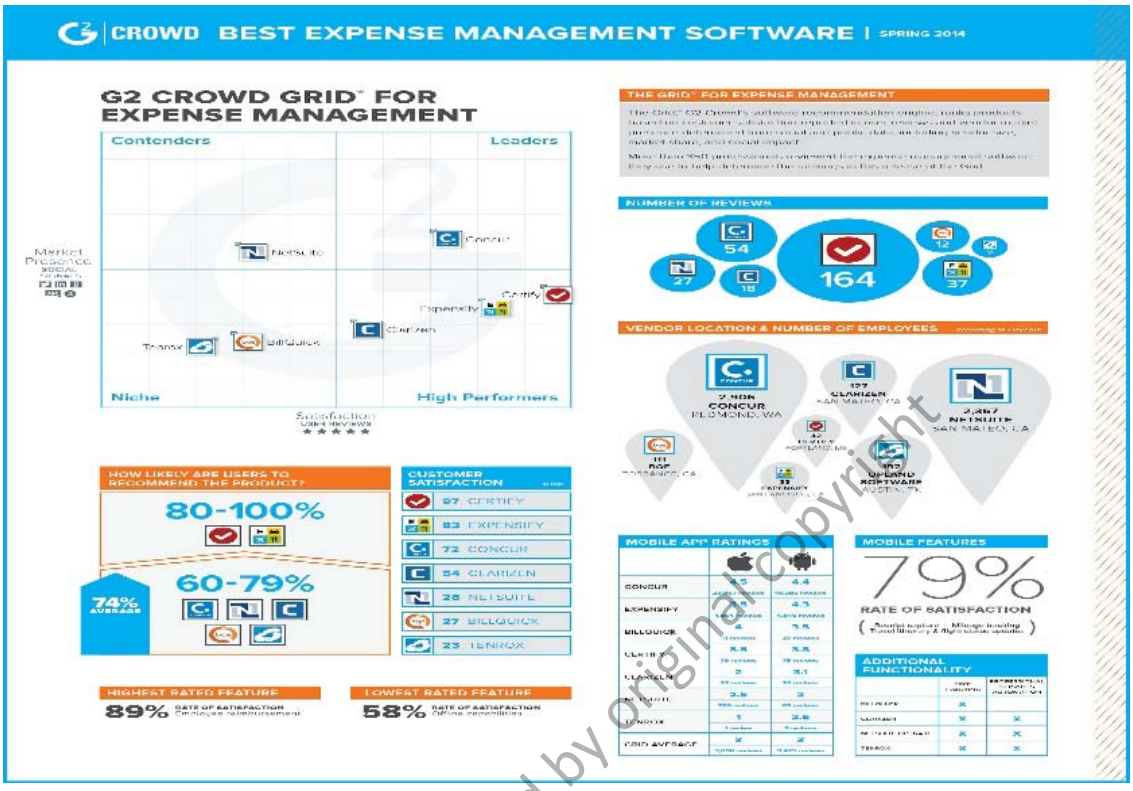

Figure 2.4: Expense Management Software Feature

An organization describe a low price because base on the hardware it wishes to move into new each part of the software market. If expenditure Management System accepting a low profit on one project give the organization the opportunity to make a greater profit later. The experience gained also help develop new products.

2.4.2 The Medium Term Expenditure Management System Approach

The exact definition of medium term expenditure System (MTES) has develop gradually according to the needs of the government device process. However, it is seen as a strategic policy and expenditure System from which better information is developed as the basis of resolution on resource allocation in line with priorities (Kianpour, et al, 2008). The World Bank (2009, p46) describes it as a process consisting of a top-down resource envelope and bottom-up estimation of

the current and medium term cost of existing policies and being, the matching of these costs with available resources. It is further stated that the objectives of MTES are to;

i. Improve macro-economic balance by developing a logical and realistic resource System.
ii. Improve the assign of assets to strategic priorities among and within sectors.
iii. Increase the commitment to predictable of both policy and funding so that ministries can plan further forward in space and programs can be sustained.
iv. Provide line agencies with a hard budget limitation and increase autonomy, and increasing incentives for expense and effective use of funds (ibid).

It is given reason that a well implemented MTES should link the government priorities with a budget within a support spending envelope; highlight tradeoffs between the competing objectives of government; links budgets with policy choice made, and improve outcomes by increasing accountability, viewed and predictability of funding.

Roberts, J. defines (Roberts, J. 2009) performance budgeting as the planning of public expenditures for the reason of achieving explicit or defied results (policy objectives/outputs, outputs of public service being done to contribution towards policy goals or intermediate outcomes). It is argued that performance budgeting allows the budget to build on the basis of anticipated workload measures that relate the activity performed to cost. Furthermore, it distribute budget resources to spending ministries and agencies on the basis of reviews of past performance and statements of future strategy, and in return for commitments to achieve defined results. In addition performance estimate and management help to; clarify policy priorities; focus expenditures more tightly on priorities, recognize the causes of good and bad performance and thereby reduce waste and increase impact easier cross institutional working, and; give fact and motivate program managers and service providers (Roberts, J. 2009).