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Development of a Short Message Service (SMS) Based Online Earth Moving Equipment Catalogue

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Abstract- Earthmoving includes site preparation, excavation, embankment construction, backfilling, dredging, preparing base course, sub base, and sub grade, compaction, and road surfacing. The types of equipment used and the environmental conditions will affect the man- and machine-hours required to complete a given amount of work.

Earth moving tools and equipment catalogue is essential for estimating onsite productivity and measuring project performance in earthmoving operations. This paper presents an online catalogue for earth moving operations Short Message Service (SMS), based system, developed for estimating performance of earth moving operations which will greatly assist contractors in selecting tools and equipment for earth works using SMS, making the system economical and efficient. The proposed system is programmed in c# programming language. The database is hosted on a MySQL and it uses Global system for mobile communication (GSM) to connect to a modem which in turn sends and receive short messages to and from the user.

The developed system has been coded and the code request must contain only alphanumeric characters. Real case example of SMS request is analyzed to demonstrate the features of the developed online catalogue.

When applied in the earthmoving industry the system can an enviable asset to contractors and increase the overall efficiency in earthmoving operations like embankment construction, backfilling, compaction and road surfacing, just to mention but a few

Key words - Earth Moving Operations (EMO), Global System for Mobile (GSM), Online Machine Catalogue (OMC), Short Message Service (SMS).

I. INTRODUCTION

Mobile phone technology has changed the way people communicate and is used for several services. In developing countries the phone is a way of accessing ICT and fueling innovation.

SMS is most preferred mobile phone communication technologies around. The country has seen increase in the use of internet and mobile phones. The number of mobile subscribers stand at 29.7million, increasing the penetration of mobile telephone to 75.4%. [1]

The growth in developing countries can be attributed to factors as:

a) Privatization of the Telkom industry which was mostly government owned allowing more players to come to the market.
b) Technological advancement such as use of wireless services.
c) Market trends especially with the use of prepaid services.
d) Ease of access to mobile phones that are now cheaply sold. [2]

We assumed all contractors in Kenya carry basic mobile phones with SMS facilities. Considering earth moving tools and equipment catalogue, we must employ basic and trusted technology to assist the users in making timely and informed decision in selection of the equipments.

In this paper the development of SMS based catalogue for EMO is presented. The literature review of various SMS based services in the construction industry is given.

The motivation for this paper is the growing popularity of mobile information systems and the need to explore if SMS is a technology that construction industry could tap into and enhance their services to users.

II. LITERATURE REVIEW

Earlier innovators in mobile phone technology were Bangladesh with a service to help solve health and agriculture problems; India with “mKrishi” messaging service to offer advise to farmers and also in Nigeria used to assist textile producers [3].

There has been an increase in using mobile devices to support management of the construction industry.

Mobile devices can be used in managing and aiding construction works from inception of the project to completion. The most stable mobile technologies SMS texting [4] on a cellular phone has great potential in the construction industry.

For the last 5 years, many SMS based projects aiding construction industry were reported. In this section, some of the projects are highlighted. These projects are being categorized into (a) Communication and administrative support (b) confirmation, information and monitoring as supported below.

2.1 Communication and Administrative Support

Optimization of information flow in the construction site captured clearly the use and integration of GSM, SMS in the construction works as illustrated below.

✓ A construction project manager goes over the project time schedule and hands out a task to a carpenter by filling in a form on the ICT system manager application. The manger application sends the task to the onsite climbox that sends an SMS notification to the carpenter.

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- ✓ The carpenter receives a text message on his mobile phone notifying him that he has a new task to perform. Text message:"*You have one new task waiting. Please log onto Climbox for further information"*
- ✓ The carpenter logs into ICT system with his identity card. The system registers that this individual carpenter prints this drawing. That way, the system does only send to him and the project manager if changes are made.
- ✓ The carpenter then prints the information needed to perform the given task. The carpenter now has all the necessary information to perform the task[5].

2.2. Confirmation, information and monitoring.

In construction industry at present too much time is consumed on paperwork [6].

This kind of double work takes too much time, and is not reliable, since papers get easily lost and handwritings are often incorrectly interpreted.

Mobile applications are needed to support the construction process, and reduce paperwork. Both groups thought mobile applications are good and efficient solution for different kinds of monitoring and control functions. Monitoring functions could also be expanded to work progress, personnel and installation time, and quality. effects Indicated by [6] of mobile safety monitoring application as illustrated in fig. 1

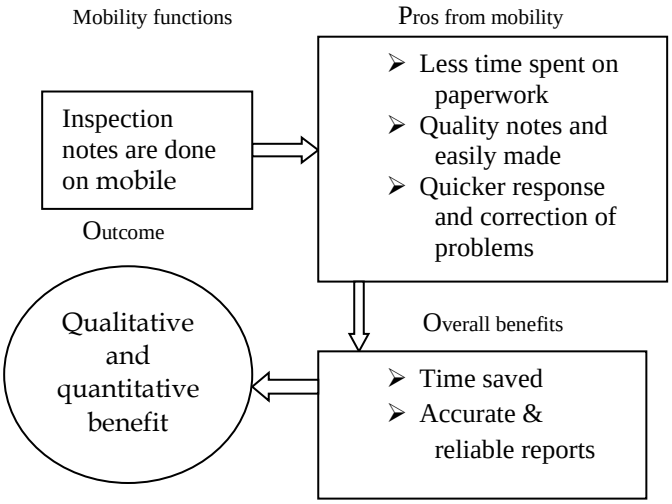

Fig. 1 Effects of mobile safety monitoring application

III. METHODOLOGY

3.1. Introduction

An over view of how the SMS based catalogue was developed, system documentation given and catalogue flow chart illustrated.

3.2 Development of a SMS Based online earth moving equipment catalogue.

3.2.1 System Design

The system runs on timer that checks incoming messages every millisecond, if inbox is detected the system pauses the timers and opens the SMS reader, the system reads the SMS and verifies that the query is correct, after checking the correctness of the query the system then checks for the corresponding response from the database if its long than the expected length its broken down into smaller SMS then sent as multiple SMSs

The system designed works as illustrated in the flow chart in fig. 2 below.

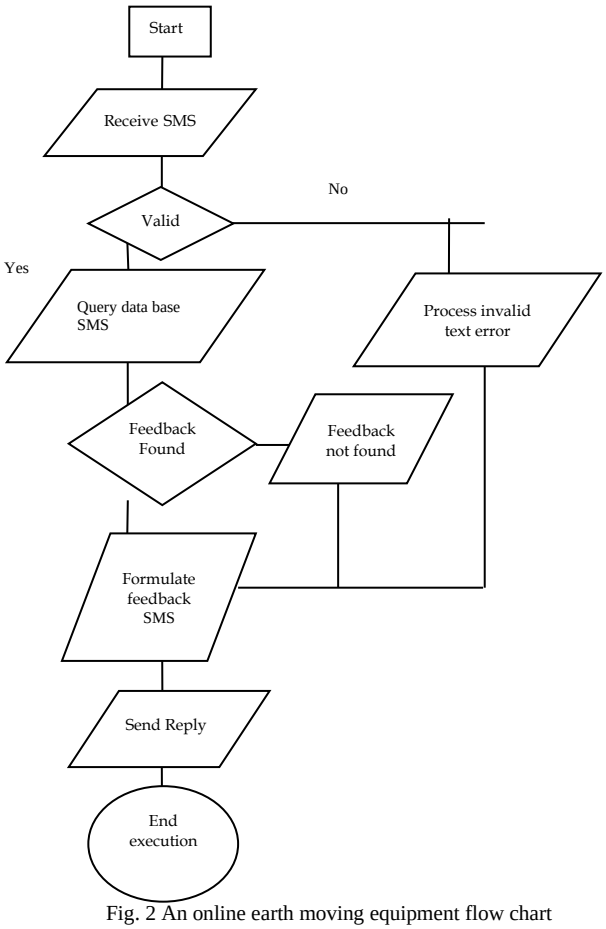

Fig. 2 An online earth moving equipment flow chart

3.2.2 System Documentation

The system is programmed in c# and the database hosted on a MySQL.

C# is an object oriented programming language from Microsoft that aims to combine the computing power of C++ with the programming easy of Visual Basic [7].

MYSQL is an open source relational database management system.

Based on structured query language (SQL) which is used for adding, removing and modifying information in the database [8].

The system uses a class called GSM comm. To connect to the modem. This in turn sends and receives text messages to and from the user. Since the system uses GSM technology it can be used with any GSM enabled modem or phone e.g. Nokia phones connected via personal computer suites.

3.2.3 Data Flow Diagram (DFD)

A DFD is a modeling tool that allows analysts to picture a system as a network of functional processes connected to one another by flows and data stores. They illustrate how data (inputs) are processed by the system into information (output) [9]

Terms used

Process

Process is that part of the system that transforms inputs into outputs and is illustrated in Figure 3

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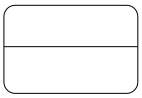

Fig. 3 Process representation

Flow Line (Data Flow)

This is represented by an arrow into and out of a process. It is used to describe the movement of packets of information from one part of the system to another.

Fig. 4 Flow line representation

Data store

This is a database or where data is stored.

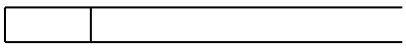

Fig. 5 Data store illustration

Entities

These are external entities with which the system communicates. They are the sources and destinations for the system's inputs and outputs.

Fig. 6 Entity illustration

3.2.4. Database design

The back end database development was implemented using MS SQL 2000 server. This software was chosen because;

- It has powerful data handling and processing capabilities making it an overall lead in developing an application that has high data requirements.
- It is easier and faster to build a database since it is readily structured.

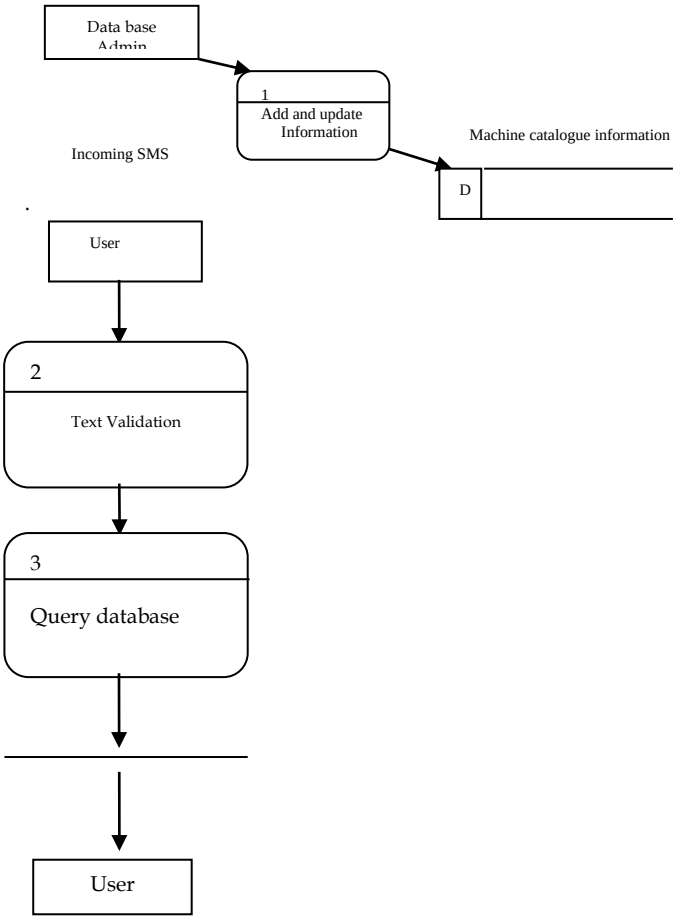

Fig.7 Data flow diagram illustrated.

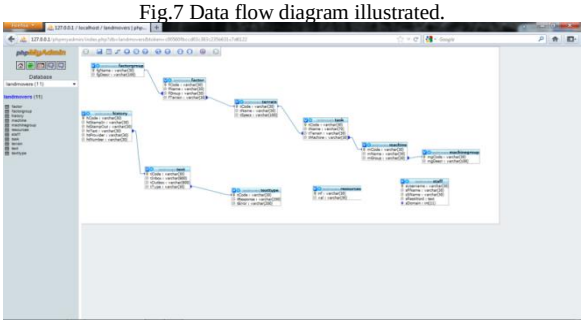

Fig. 8 Project Database screen shots [10]

Fig. 9 Modem settings connection screen shots

Fig. 10 Test-pane results of specific codes screen shots

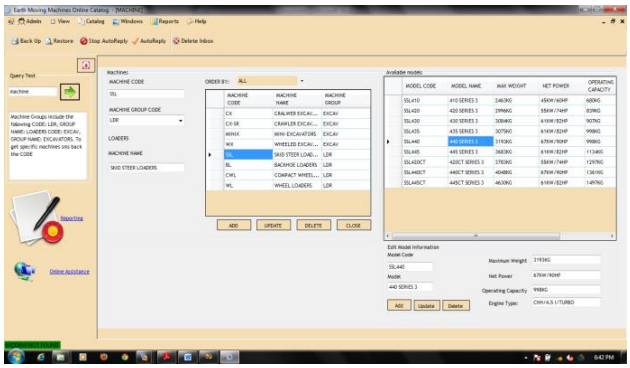

Fig.11 Adding and updating the database content Screen shots

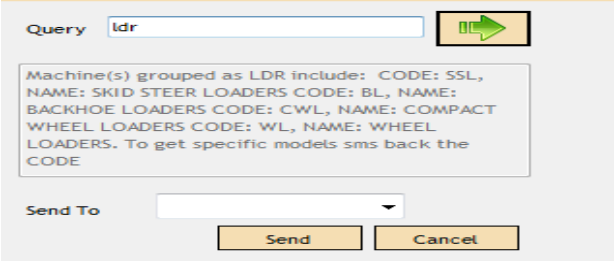

Fig. 12 SMS queries and response screen shots [11]

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IV. RESULTS, ANALYSIS AND DISCUSSION

4.1 Introduction

The development of a SMS based online earth moving equipment catalogue is analysed in details.

4.2. System Performance

After the SMS based online earth moving equipment catalogue is developed. How the system can perform and the results of the tests are discussed in the following sections.

4.2.1 Request initiated by the user

The user of a machine sends a request 'machine' to a designated telephone number (While for the purpose of this research 0720 986 150) at a fee as any other SMS tariff as illustrated below in fig. 13

4.2.2 First response to User

The response to the message the system will give will be as illustrated below In Fig 13.

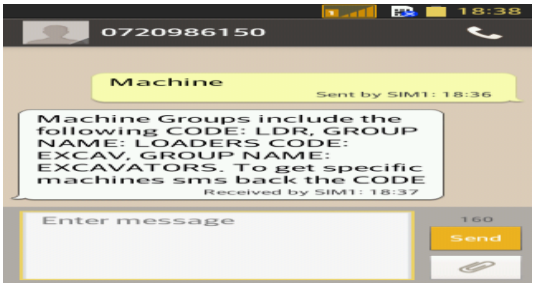

Fig. 13 Showing first response and query from system and user

The response above in fig. 14 reads; Machine Groups include the following code include the following CODE: LDR, GROUP NAME: LOADERS CODE: EXCAV, GROUP NAME: EXCAVATORS. To get specific machine SMS back the CODE

4.2.3 Second request by the user

The user after getting the first response sends a second request as advised in the first response, example for this case he sends EXC as illustrated in Fig 14.

4.2.4 Second response to the user

The second response gives out the type of specific machines available. This informs the decision of the user. An illustration of a second response to a user in fig. 14 next page after the user had queried the first response using code Exc.

The response above in Fig. 14 reads; Machine(s) grouped as EXC include: CODE: CX, NAME: CRAWLER EXCAVATORS CODE: CX-SR, NAME CRAWLER EXCAVATORS SR CODE: CX-SR, NAME: MINIX, NAME: MINI EXCAVATORS CODE: WX, NAME: WHEELED EXCAVATORS. To get specific models SMS back the code.

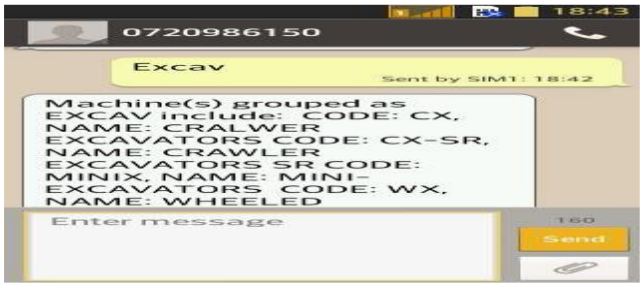

Fig. 14 Showing second response and query from system and user

4.2.5 User querying the system's second response

The user lastly queries the system's second response by sending an SMS as guided by the systems second response example is like a WX for wheeled excavators as in the case illustrated in fig. 15 below.

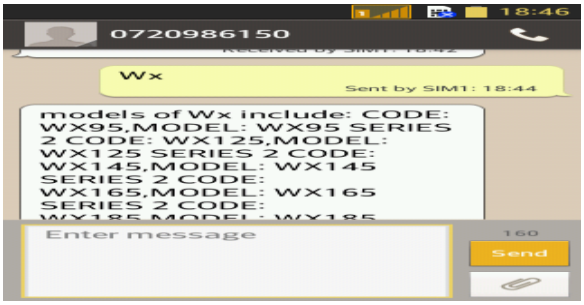

Fig. 15 An illustration of a third response and query from system and user

The above SMS query reads; WX.

4.2.6 Third and final response to user

The system after getting the third query from the user as illustrated in fig. 15 it gives a third final response giving details of the specific machine requested which assist the user in making decisions in selecting earth moving equipment as illustrated in fig. 15. If the user is okay the process can end there but if he is not he can start from request number one and go through the process again and selecting other components.

The response above in figure 15 reads; Models of Wx include: CODE:WX95 SERIES 2CODE:WX125,MODEL:WX125 SERIES 2 CODE: WX145 ,MODEL: WX145 SERIES 2CODE:WX210,MODEL:WX210 SERIES 2 CODE:WX240,MODEL:WX240SERIES 2

4.3 Limitation of the system

As pointed out earlier in the paper. The SMS approach has the advantage due to basic mobile phones readily available to contractors. The system however cannot be used as a replacement of a traditional catalogue to support decision making in selection of earth moving tools and equipments.

Firstly, SMS technologies can only be used to provide byte size content or interaction; hence information has to be summarized especially from the system to the user.

Secondly, although the cost to send and receive SMS is small it's a major concern for a repeated interaction between the system and the user. Some solutions to this problem do exist. Example a free SMS services within the same mobile providers. Bulk purchases of SMS services from service providers at affordable prices.

Nevertheless the operational cost can be a prohibitive factor for SMS based earth moving machine catalogue. Other limitation includes; one fingure operation, battery life spans, network can also be an issue and may result to slower transmission of SMS messages and hence resulting to inefficiency.

V.CONCLUSION

In this paper the development of an SMS based earth moving equipment catalogue is described. GSM modems are used to support the earth moving catalogue needs.

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For efficient and timely determination of earth moving tools and equipment our approach of using GSM modems is ideal compared to referencing on paper catalogue which are very difficult to get.

The technical aspect of such a system can be updated with as many earth moving tools and equipments specifications by expanding the existing data base to suit the market needs, this can be done in liaison with manufacturers of earth moving tools and equipments.

The limitations of the system are revealed. Inspite of these concerns, we believe that our system can enhance the earthmoving operations experience that is different from the traditional paper referencing methods by taking advantage of ubiquitous nature of mobile phones and readily available infrastructure of SMS.

VI. APPENDIX

System installation guidelines.

1) System components

- Microsoft SQL Server 2000 Edition
- An Installable version of the SMS BEMPEC (Short Messages based Earth Moving Plant and Equipment Catalogue) is provided

i. First install MS SQL 2000 into your computer.
ii. Using the installation package provided, double click to start the installation process
iii. After installation create a desktop icon

2) Running the System

Double click on the icon of SMS BEMPEC created in the programs menu. Enter the supplied password and clicks enter to login.

3) Suggested System Specifications

To attain the best performance while running the system, the following suggestions should be followed:

i. Have a screen resolution of at least 1024 by 768 pixels.
ii. Memory: at least 256 MB of RAM
iii. Processor: preferably 1.4 GHz or higher
iv. Hard Disk space: at least 10GB.
v. Operating System: Windows XP [9]

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