DEVELOPMENT OF A MOBILE MATHEMATICAL EXPERT SYSTEM (MMES)

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Abstract
Mathematics being an established discipline has provided methods of solving all forms of mathematical problems. However, the ubiquitous advantage brought by Information Technology (IT) can be extended to Mathematicians. This drives motivates the researchers in this work to develop a Mobile Mathematical Expert System (MMES) capable of solving some mathematics problems using the mobile phone. Having specified the algorithm for the selected mathematical problems, J2ME is used to develop the system.

Keywords: Mobile, Mathematical, Expert, System, J2ME, Algorithm

Introduction

Mathematics is an abstract study of number, quantity, and space. It is also the study of the measurement, properties, and relationships of quantities and sets using numbers and symbols. This is the systematic treatment of magnitude, relationships between figures and forms and relations between quantities expressed symbolically. The branch of mathematics includes Arithmetic, algebra, geometry, and calculus.

Algebra: This treats the representation and manipulation of relationships among numbers, values, vectors, etc.

Geometry: This treats the measurement, relationship, and properties of points, lines, angles, and figures in space.

Calculus: This treat the measurement of changing quantities, determining rates of change and quantities under changing conditions.
Mathematics Expert this is the collection of formulas out of mathematics, which is ready to gives the user immediate help.

The first mobile telephone calls were made from cars in 1946. Bell System's Mobile Telephone Service was made on 17 June in St. Louis, Missouri, followed by Illinois Bell Telephone Company's car radiotelephone service in Chicago on 2 October. The MTA phones were composed of vacuum tubes and relays, and weighed over 80 pounds (36 kg). There were initially only 3 channels for all the users in the metropolitan area, increasing later to 32 channels across 3 bands. This service continued into the 1980s in large portions of North America. Due to the small number of radio frequencies available, the service quickly reached capacity. In 1956, the world's first partly automatic car phone system, Mobile System a (MTA), was introduced in Sweden (Heeks, 2008).

John F. Mitchell, Motorola's chief of portable communication products in 1973, played a key role in advancing the development of handheld mobile telephone equipment. Mitchell successfully pushed Motorola to develop wireless communication products that would be small enough to use anywhere and participated in the design of the cellular phone. Martin Cooper, a Motorola researcher and executive, was the key researcher on Mitchell's team that developed the first hand-held mobile telephone for use on a cellular network. Using a somewhat heavy portable

handset, Cooper made the first call on a handheld mobile phone on 3 April 1973 to his rival, Dr. Joel S. Engel of Bell Labs.

All mobile phones have a number of features in common, but manufacturers also try to differentiate their own products by implementing additional functions to make them more attractive to consumers. This has led to great innovation in mobile phone development over the past 20 years (Khurana, Kundi & Murphy, 2009).

Mobile phones are used for a variety of purposes, including keeping in touch with family members, conducting business, and having access to a telephone in the event of an emergency. Some people carry more than one cell phone for different purposes, such as for business and personal use (Saylor, 2012).

The future of mobile computing is becoming even more exciting. Mobile devices are continually growing more capable, especially with the advent of cleverly integrated phone capabilities. With better and better wireless networks capable of transferring media in real time, an entirely new breed of applications is now possible. Riding this new wave may be extremely profitable for organizations positioned to take advantage of it (Murphy, 2009), (Burnette, 2008).

There is a flood of interest in software development revolving around J2ME (Java 2 Micro Edition). J2ME is a slimmed-down version of Java targeted at devices that have limited memory, display, and processing power.

There will be a specific focus on application development for mobile devices using an application programming interface (API) known as the Mobile Information Device Profile (MIDP). Applications written for this API are affectionately referred to as MIDlets.

A MIDlet is an application that uses the Mobile Information Device Profile (MIDP) of the Connected Limited Device Configuration (CLDC) for the Java ME environment. Typical applications include games running on mobile devices and cell phones which have small graphical displays, simple numeric keypad interfaces and limited network access over HTTP (hypertext transfer protocol) (Topley, 2002).

The user downloads the .jad file and installs the MIDlets they require. Local deployment requires that the MIDlet files be transferred to the device over a non-network connection (such as through Bluetooth or IrDa, and may involve device-specific software). Phones that support microSD cards can sometimes install .jar or .jad files that have been transferred to the memory card.

Material and Method

The programming language used in this paper is java 2 Micro Edition (J2ME). to develop mathematical library, capable of solving selected mathematical equations such as Quadratical equation, Simultaneous equation, Arithmetic progression, Geometrics progression. J2ME combines a resource constrained JVM (Java Virtual Machine) and a set of Java APIs for developing applications for mobile devices.

The most popular profile and configuration that Sun provides are the Mobile Information Device Profile (MIDP) and Connected Limited Device Configuration (CLDC), respectively. As the name suggests, CLDC is for devices with limited configurations; for example, devices that have only 128 to 512KB of memory available for Java applications. Consequently, the JVM that it provides is very limited and supports only a small number of traditional Java classes. (This limited JVM is actually called the *KVM*.) Its counterpart, the Connected Device Configuration (CDC) is for devices with at least 2MB of memory available and supports a more feature-rich JVM (but still not a standard JVM).

Java emulator is a tool that helps for java-based software can run on your computer's operating system. So that we can play a variety of applications java example games, music, videos etc as in mobile phones. Because it is, a java emulator so application must have the extension Jar or Jad and computer must be installed java platform: Java SE/*JRE* (*Java Runtime Environment*).The reason is JRE, which runs the file API of each platform java program.

Mathematical Model Formulation

In order to develop a mobile expert library, there is a need to inculcate some mathematical formulae which are: Area of Rectangle, Area of Triangle, Area of a Circle, Volume of a cube, Perimeter of Rectangle, Circumference of a Circle, Volume of a Cone, Quadratic Equation, Permutation and Combination, Volume of a Sphere, Curved Surface of an Sphere, Simple Arithmetic, Arithmetic Progression, Geometric Progression.

Assumptions in the Model

To develop a reasonable model which compresses series of formulae some assumption need to be made which are:

(i) The Measurement is taken in centimeter (cm).
(ii) Any length and breadth value can be choosen.
(iii) The model is restricted to selected formulae mentioned above.
(iv) The model is executed both on personal computer (P.C) and Mobile Phone.

L (cm) * B (cm) = A (cm) 1
Where L is the Length, B is the Breadth and A is the Area of Rectangle.

½ * B * H = A 2
Where B is the Base, H is the Height and A is the Area of Triangle.

TI * R = A 3
Where TI is Pie, R is Radius and A is the Area of Circle.

L * B * H = V 4
Where L is Length, B is Breadth, H is Height and V is the Volume of a Cube.

Perimeter of Rectangle: 2 x (length + height)
2 * (L + H) = P 5
Where L is length, Height is Breadth and P is the Perimeter of Rectangle.

2 * TI * R = C 6
Where TI is Pie, R is Radius and C is Circumference of a Circle.

1/3 * TI * R = V 7
Where TI is Pie, R is Radius and V is the Volume of a cone.

- B +- Sqrt (B^2 – 4*A*C)/ (2*A) = X 8
Where A, B, C are the Variable in (cm) and X is the root of Quadratic equation.

N! / (N-R)! = nPr 9
Where N and R are the variables in (cm) and nPr is the Permutation of a number.

N! / (N-R)! R = nCr 10
Where N and R are the variables in (cm) and nCr is the Combination of a number.

Simple Interest: (P * R * T) / 100
P * R * T/ 100 = SI. 11

Where P is Principal, R is Rate, T is Time and SI is the Simple Interest.

A^2 + O^2 = H^2 12
Where A is the Adjacent, O is the Opposite and H is the Hypotenuse.

4/3 * TI * R ^ 3 = V 13
Where TI is the Pie, R is the Radius and V is the Volume of a Sphere.

4 * Pie * R ^ 2 = C 14
Where TI is the Pie, R is the Radius and C is the Curved Surface of a Sphere.

A+ (N-1) * D = Tn 15
Where A is the first term, N is the Number, D is the common difference and
Tn is the number of A.P term.

AR^N-1 = Tn 16
Where A is the first term, N is the Number, R is the common ratio and
Tn is the number of G.P term.

Results and Discussion
These figures below show the output of mathematical software library that was developed for mobile phone.

Computation and output of area of a rectangle
Once you run the jar file on your phone, the list of mathematical problems will be displayed, based on what the developer develop. This particular phrase computes the area of a rectangle by entering the value of length and breadth in the text field and select compute or menu before compute depending on the configuration of your phone. This is described in Figure 3.1.

Fig. 1: The result of Area of a rectangle with length 7cm and breadth 9cm

Discussion on the Area of a Circle by enter the radius
This section display the area of a circle by entering the radius in centimeter (cm), then the compute button will be pressed in order to achieve our aim. In order to compute the result on these types of phone you will need to select menu and then click the compute label, by doing so the area of a circle will be displayed in the area textfield. The type of phone used is any java phone.

Fig. 2: The result of area of a circle with radius 9

Compute the area of Triangle

To compute the area of a triangle will need the base and the height of that triangle. Here you will be required to enter the base and the height in a textfield and the result will be generated for you by clicking the compute button.

Fig. 3: The result of area of a triangle with base 7.2cm and height of 9.5cm

Discussion on the Volume of a Cube

All the paper work, analysis and manipulation has been hidden from the user with just a simple program, what the user need to do is to enter the length, breadth and height and the solution will be given in a blink on an eye.

Fig. 4: The volume of a cube with Length 4.5cm, breadth 3.7cm and height of 8cm

Discussion on the Volume of a Cone

This is another area of mathematics that bothers the students in calculating, but with the help of this software, the student will be able to calculate this easily.

Fig. 5: The result of a volume of a cone with a radius of 7.6 and height of 9

Computation of the roots of Quadratic Equation

This is another segment of mathematical problem that is made simpler. This part consists of 6 text fields which include A, B, C, output (D) and the root1 and root2, pertaining to the almighty formula. In which the output will be display if D<= 0 else the roots will be displayed.

Fig. 6(a): The Figure above display the Complex Root in the output box because D < 0. The textfield A, B and C was entered to be 2, 1 and 3 respectively

Fig. 6(b): Computation of Quadratic Equation Roots when D > 0 (D is greater than Zero)

Fig. 6(b): The Root1(X1) and Root2(X2). A, B and C are inputed to be -3, 2 and 3 respectively. The Figure describes Computation of Quadratic Equation Roots when D = 0 (D is equal to Zero).

Fig. 6(b): The Root of the Equation is the same. A, B and C are inputed to be 1, 5 and -2 respectively

Fig. 6(c): The Root of the Equation is the same. A, B and C are inputted to be 1, 5 and - 2 respectively

Solution to the value of X and Y in Simultaneous Equation

This session require the user to input series of value inform of the linear equation. For instance if the problem to be solve is 2x + 3y=15 …. (Equ. 1) and the equation 11 is 3x – 4y = 10… (Equ. 2). Now do this using this software, you will enter 2 to field X1, 3 to Y1, 3 to X2, 4 to Y2, 15 to C1 and 10 to C2 then click compute button, the result will be display kin X and Y textfield.

Fig. 7: Shows the value of X and Y used in solving the simultaneous equation

Discussion on Simple Arithmetic

The figure below shows the use of mathematical arithmetic operator such as Addition (+), Subtraction (-), Multiplication (x), Division (/) and modulus (%). you will be prompt to enter

numbers in the text fields and then click on menu to select any arithmetic operator of your choice. The modulus gives operator provides you with the remainder of divided number.

Fig. 8: How to perform some simple arithmetic operations

List of others Mathematical Solution

The figure below shows the list of some other mathematical solution such as Permutation, Combination, AP, GP, and Simple Interest and so on.

Fig. 9: List of others mathematical Solution

Conclusion and Recommendation

This research work has a lot of benefit to the students at all level of academic stages. Especially where objective questions are require to be answered. It is recommended for use for the following reasons.

(i) It makes it easy to solve any objective based questions.
(ii) It eliminates the time consumed in solving the solution on the paper.
(iii) It makes it easy for any phone user to provide solution to some mathematical problem.
(iv) It enhances student's performance to objective part of mathematics.
(v) It can serves as alternative when calculator is not in use.
(vi) It can be used in confirming results from other alternative source of calculations.

Further Research

This paper can also be developed further by not concentrating only the Mathematical Functions, but also catering for solving general calculations in Physics on Mobile Phone, Brain Test and Mobile Phone Encryption.

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