Smart number cruncher – a voice based calculator

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Abstract. ‘Smart Number cruncher- A voice based calculator’ is an electronic device which perform lengthy calculations. Traditional calculator uses key input to perform calculations, which is time consuming process. Present invention developed a new way of calculation. Smart number cruncher provides two modes of calculation, first mode is text mode and second mode is voice mode. Text mode performs mathematical calculation by typing numbers and symbols which is same as normal calculator. Voice mode takes voice input from user in the form of speech and performs mathematical calculation. Voice mode gives output in the form of voice only. This mode of calculation is easier than the regular text mode. Voice mode based calculation is useful for physically handicapped people. Smart number cruncher is user friendly since this system supports multiple regional languages. Smart number cruncher is based on various languages, initially user have to select the mode that is text mode or voice mode. On selection of voice mode user have to select language to perform mathematical calculation. Switching between regular text mode and voice mode, mathematical calculation, language selection all operations are done by micro-controller. All the operations done by voice mode are same as regular text mode internally. Proposed device is useful for the physically handicapped person as well as illiterate people. It saves lot of time wasted on lengthy calculations done by regular calculators. User doesn’t have to press any type of keys in the voice based calculator. Smart Number Cruncher is affordable to common people and easy to use.

Keywords: Smart number cruncher, text mode, voice mode, traditional calculator

1. Introduction

A recent survey directed among individuals performing calculations regularly shows that they lean toward utilizing a separate calculator rather than a calculator present in their work station PCs to spare time and accomplish performing various tasks. They recommended that utilizing the PC based calculator is tedious as they need to change screens and this prompts composing mistakes. Given a choice, they would prefer to favor a voice initiated adding machine running out of sight on their PCs, to which data sources can be given as spoken digits and tasks, and would show the outcome on the screen. This voice enacted number cruncher can be executed on a fundamental PC framework with no extra equipment.

Number cruncher is a computer or program capable of performing rapid calculations with large amounts of data. Another name for number cruncher is calculator. An electronic calculator is a small, portable electronic device which is used to perform calculations, such as basic arithmetic, complex mathematics, complex calculations etc. Many small scale as well as medium scale shops currently

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using calculator to perform calculation and to perform this calculation it takes more time because of key input as well as input limitation. In the various places various people using calculator day by day to perform basic as well as complex mathematical operations. These operations are done by those people who know which key used for which purpose. But there are some limitations to this calculator. Like these calculators cannot be used by the people who are unable to see, also these calculator having number limitations etc.

These limitations are overcome by inventing, smart number cruncher. Smart cruncher is voice based calculator which takes voice input to perform the various calculations. It takes voice as an input to perform operations, so time to perform operations are reduced automatically. Also this smart number cruncher input limitation is also reduced. Smart number cruncher have microcontroller through which it takes voice input from user and convert this input into text to perform calculation. After calculation this output will be displays on display unit as well as text output is the converted into voice.

A smart Number cruncher - a voice based calculator, is an electronic number cruncher helps user to perform calculation fast. Smart number cruncher having two modes which allows user to use number cruncher as normal calculator which take text input as well as voice based calculator which takes voice input from user. The focus of invention is related to reduce time required to perform lengthy calculations. It involves capturing physical characteristics of user such as voice. This voice is used as input to perform calculation which saves time. As traditional calculator uses text input which takes time to enter input and search key also in traditional calculator. In traditional calculator user cannot give more than 35 inputs at a single time. This smart number cruncher is also helpful for physically challenged people. A smart number cruncher is a device performs lengthy calculations fast. Traditional Calculators are key input based. For every calculation user has to enter keys for number and operations which is time consuming also illiterate people cannot use normal calculator. Traditional calculator will not support lengthy calculation at a time which is having some input limit at single time. This device provides new way of calculator which is based on voice.

This smart number cruncher takes voice input from user to perform calculations and gives voice output to user. Since it is voice based time required to search keys and enter is reduced as well as any mistakes of entering numbers and operator also get reduced. Smart number cruncher is also used as normal calculator as this device also has text mode option.

In this way smart number cruncher overcomes the disadvantages of traditional calculators and provides a best solution to perform lengthy and complex calculations based on voice mode. There is no chance of error in the calculation because user giving input orally and operation performed on the user given data and displayed in the form of voice mode. This device is helpful for physically handicapped and illiterate people. Also easy to use and affordable to common people.

1.1 Market Survey

The figure 1 shows survey of regular traditional calculator and Smart Number Cruncher. Smart Number Cruncher is more demand of the user; it calculates the mathematical sums by two ways that is text mode and audio modes. Smart Number Cruncher is more important for the user, 90% user demanding the Smart Number Cruncher, so here develops this type of system used in any electronic devices for calculation purpose.
2. Related Work

2.1 Reese Robert, Combination wristwatch and calculator (Patent no: US 3928960 A)

Reese [1] designed a blend of wristwatch and calculator using a typical electro-optical digital display. A period and schedule circuit is joined with an adding machine circuit, both framed by large scale reconciliation, and used to incite basic presentation stations of a light emitting diode digital display. Time is always kept however the calculator circuit is just endless supply of an "calculate mode" change to preserve battery energy. Additionally uncovered is a solar cell for energizing the battery and a repress clock for naturally dousing the display when the gadget is in the calculate mode however not being used.

2.2 Hiroaki Sakoe, Speech recognition system (Patent no: US 4239936 A)

Hiroaki [2] disclosed a speech recognition system adaptable to noisy environments. The system includes a recognition unit for recognizing input speech signals and a noise measuring unit for measuring the intensity of ambient noises. The system also includes a rejection unit responsive to a rejection standard controlled by the intensity of the measured noise for rejecting the rejection results given from the recognition unit when the rejection standard is exceeded.

2.3 Heihachiro Ebihara, Fukuo Sekiya, Takashi Yamada, Portable electronic device equipped with calculation and timekeeping functions (Patent no US 4266278 A)

Heihachiro et al [3] developed a versatile electronic gadget with calculation and timekeeping capacities, furnished with a console for computation and time setting purposes, implies for delivering scanning signals when a key is incited, these signals being applied to exchanging components associated with rows of keyboard contacts. At the point when a key is depressed, the resultant elevated level sign potential applied to the relating contact push causes the line position to be recognized and put away in a first memory circuit, which delivers a sign making the comparing contact section be identified and put away in a subsequent memory circuit. Activation of an external control part makes a
sign be put away by a reset sign in a first stage memory circuit which creates a output signal to be along these lines put away in a second stage memory circuit in synchronism with a timing signal. The low frequency and low duty cycle of the scanning sign and reset signal guarantee limited power utilization and concealment of switch bounce impacts.

2.4 Der Lely Cornelis Van A compact electronic calculator (Patent no EP 0212759 A1)

This invention relates to a compact electronic calculator to be worn as a pocket or wrist calculator or as a necklace. It is provided with a screen and at least one operating device to be actuated by human voice. The calculator operates by voice recognition.[4]

2.5 Cornelis van der Lely Voice activated compact electronic calculator (Patent no US 4882685 A)

A compact electronic mini-computer containing a screen, electronic circuits, a microphone, voice acknowledgment circuits which are interchangeable relying on the setting of the verbal information to be gotten by the calculator and the language wherein the information is given. The calculator is therefore receptive to numerals and images communicated in a chose language or dialects and this is changed through the hardware of the calculator to be seen on a stretched display unit. Calculator is additionally receptive to activity words, for example, "multiply", "divide", "add" and "subtract", so the calculator carries out these capacities on the showed numerals and images. The calculator doesn't have a keyboard and is of a little size, roughly ten centimeters long, one centimeter in width and one-half centimeter inside and out. It very well may be fused in a pen structure or, in a littler form, consolidated into a wristband or something like that. The microphone is ideally uni-directional in spite of the fact that it might likewise be to such an extent that it gets voice signals from different directions. The calculator is customizable so extraordinary chosen acoustical decibel levels might be required to incite the calculator. [5]

2.6 Marc Robeljo, Conrad Robeljo Loan calculator (Patent no US 20050086157 A1)

A device and method for calculating loan factors based on answers to questions generated and displayed on a user input device. [6]

3. Smart Number Cruncher – A Voice Based Calculator

‘Smart Number cruncher- A voice based calculator’ is an electronic device which is useful for user to perform lengthy calculations. Traditional calculator uses key input to perform calculations which is time consuming process. This device present a new way of calculation. Smart number cruncher provides two modes, first one is text mode which is same as normal calculator and second one is voice mode. Voice mode takes voice input from the user to perform mathematical calculations. It displays output in the form of voice form only. A micro-controller chip is used to perform voice interaction, mathematical calculation as well mode switch kind of operations. Initially user have to select the mode of operation that is text mode or voice mode. According to selection of mode operation will be performed. This invention is useful for physically handicapped people. Smart number cruncher is user friendly since this system supports multiple regional languages. Smart Number cruncher can overcome the limitation of numbers and typing problems in the calculator. This type of calculator can be used in laptop, mobile phones, desktops etc. Smart Number cruncher is helpful for common people, handicapped people as well as illiterate people also. Because these all people can use voice mode to perform their day today mathematical operations. It supports multiple languages in the voice mode. This system is easy to use as like common calculator.
4. Implementation Details

4.1 ‘Smart Number Cruncher- A voice based calculator’

Figure 2. ‘Smart Number cruncher- a voice based calculator’

Figure 2 shows Complete Block Diagram of Smart-Number Cruncher. It comprises of text input, voice input, smart number cruncher, operation module and display module. Input to the Smart number cruncher will be either text input or voice input. Smart number cruncher is having operation module which is responsible for performing calculations on input data. After processing input data or operations performed by operation module the output of calculation is sends to display module. Display module displays output on display as well as voice output will also sends to user. Smart number cruncher consists of two modes text mode and voice mode. It depend on user choice by which way he has to perform mathematical functions. Text mode performs mathematical calculation as per traditional way of calculator. On selection of voice mode user can perform the mathematical calculation using speech or voice mode. In the smart number cruncher operation module is defined, which performs the calculation by text mode or voice mode as per user choice. As user selects voice mode, he has to select the language, for instructing device. The device takes voice as an input and performs calculation in the operation module. As calculations are done by device displayed in the form of voice only to the user. If user have selected text mode then output of the calculation displayed on the LED display of the calculator. This operation has been performed by display module of the smart number cruncher.

4.2 Modes of Smart Number Cruncher

Figure 3. Modes of Smart Number Cruncher

Figure 3 shows modes of Smart number cruncher. Smart number cruncher system has two modes, one is text mode and other is voice mode. Text mode of Smart number cruncher works as normal calculator and takes input through key press. Voice mode of smart number-cruncher system is voice based calculator which takes voice input from user to perform calculations.

Smart number cruncher consists of two modes of operation that is text mode and voice mode. Text mode of the calculator is the way of calculation we can see normally in any type of calculator. In the calculator user presses button on the device and performs the calculation. The result of the calculation
is displayed on the display unit of the device. This mode of operation is present in the smart number cruncher. Along with text mode, voice mode is introduced in the proposed system. In the voice mode instead of text display voice form is used as an input and provides voice form as an output. These two modes of operation are introduced in the smart number cruncher for the users who are unable to operate the text mode of the calculator. Many time fraud people can take advantage of illiterate people while calculating some deals regarding money. This invention is helpful to these people to stay away from such a kind of people in the society.

4.3 Complete Work Flow Diagram of Smart Number Cruncher

![Flow Diagram](image)

**Figure 4.** Complete Work Flow Diagram of Smart Number Cruncher

The Figure 4 shows workflow diagram of Smart Number cruncher. Once smart number cruncher is get power on, then smart number cruncher ask to select input mode. Smart number cruncher provides two
options; one is text mode which works like normal calculator. Another option is voice mode. When user selects voice mode then smart number cruncher ask to select language. User will enter the input numbers. For long calculations input number will store in temporary memory to perform operation and result will displays on screen. The workflow of the smart cruncher will be as like seen in the Figure 4. As it defines how smart number cruncher works step by step. Here when user wants to perform calculation of some numbers, user switched on the device. As user power on the device, its user choice which mode of operation he requires. Depend on user choice; he can select either text mode or voice mode. If user selects text mode, then user enter the number and mathematical operator to perform the calculation. All this kind of data stored in the temporary memory of the calculator. On completion of mathematical operation final result is displayed on the display unit that is LED display of the calculator.

This mode of operation done same way as that of regular or traditional calculators. Along with this mode of calculation if user selects voice mode, then user have to select the language for instructing the device. As smart number cruncher supports multiple language so user can select his own language for calculation purpose. On selection of language user speak out the number and operator with the help of microphone mounted inside the calculator. A user instructs the calculator, calculator converts speech in to binary code. It stores user defined data in the temporary storage of the device. On completion of calculation again binary data converted in to voice mode. This voice mode output is given to the user with the help of speaker to the user. This device can be mounted in any type of electronic device which having calculation facility. Text mode output and voice mode output is presented to the user with the help of display result module of the device.

4.4 Complete block diagram of voice mode of Smart Number cruncher

The Figure 5 shows Complete Block Diagram of Voice mode of Smart-Number Cruncher. When user selects Voice mode of smart number cruncher then system will ask user to select/choose preferred language. Audio input is given to smart number cruncher system. Analog to digital converter converts this audio input to digital form (binary code). The acoustic model used in automatic speech recognition to break the words into the phonemes. Language model compares the phonemes to words in its built in dictionary to predict next word in dictionary. Then speech engine model convert this audio input to text. Smart number cruncher perform operations on this data and sends result to display unit which displays result using LED display. Figure 5 shows working of smart number cruncher in voice mode. Once user selects voice mode of the smart number cruncher, user have to give voice as an input to the device. To give input to the device user have to select the language which he knows. So user have to select the language to give an input. On selection of user preferred language user gives audio input to the device. As everyone knows that computer or any electronic device works on digital signals. So user given input is in the form of analog signals which need to be converted in the digital
signals, with the help of analog to digital converter. Digital signals are given to the acoustic model. An acoustic model is used for Automatic Speech Recognition. An acoustic model represents the relationship between an audio signal and the phonemes or other linguistic units. This model takes a set of audio recordings as an input.

This model creates statistical representation of speech recordings which are taken as an input. A label called as phonemes are assigned to statistical representations. In English language 40 distinct sounds are used for speech recognition, and so that it is having 40 different phonemes. An acoustic model is created by taking a large database of speech (called a speech corpus) and using special training algorithms to create statistical representations for each phoneme in a language. A statistical language model is a probability distribution of sequences of words. The language model is used to distinguish between words and phrases of similar sound. Language modeling is used in speech recognition, machine translation, part-of-speech tagging, parsing, handwriting recognition, information retrieval and various applications. A speech engine model is a type of software that gives computer the ability to play back text in a spoken voice (referred to as text-to-speech or TTS). A text-to-speech (TTS) system converts normal language text into speech; other systems render symbolic linguistic representations like phonetic transcriptions into speech. After these transformations actual mathematical calculation takes place and the audio signal are sent to display unit. This unit again performs reverse operation to send audio form output to the user.[8][9][10][11].

4.5 Complete block diagram of text mode of Smart Number Cruncher

Figure 6 shows Complete Block Diagram of Text mode of Smart-Number Cruncher. User selects text mode of Smart number cruncher. Text mode of smart number cruncher is used as normal calculator. When user press any key sensor sense that key/number which is used to perform calculation. Result is then send to display module which displays results. In the text mode of the smart number cruncher normal mathematical calculation takes place as like normal traditional calculator. Here user gives input to the device by pressing the keys present on the device along with the operator to perform mathematical calculation. Once user press any key a rubber button is pressed underneath. When you press a key, the rubber button pushes down making an electrical contact between two layers in the keyboard sensor underneath and the keyboard circuit detects this. The processor chip figures out which key you have pressed. A circuit detects the button which user has pressed along with the operation button and performs the operation with the help of memory.[8]. At last processor displays the output on the display unit which is LED display of the device.
4.6 Smart Number Cruncher System architecture

Figure 7 shows Smart-Number Cruncher System Architecture. User of smart number cruncher is interacting with system through providing either text input such as normal calculator or voice input. Microphone of smart number cruncher takes voice input from user. Once input signal is received by smart number cruncher system, filter filters signal to remove noise then this voice is converted to text. Smart number cruncher performs calculations and displays result on screen as well as result is again converted into voice. To convert text into speech first text analysis is done then linguistic analysis is done and waveform is generated and through speaker voice output result is given to user. A smart number cruncher having kind of modification in the hardware part.

This hardware part includes microphone and speaker. Microphone requires to give input and speaker requires to give output to the user in the form of voice. As user gives voice input to the device, this is given by microphone mounted inside the calculator. It receives signal and send to the filter to minimize any form of noise in the audio signal. Also filter enhances the quality of the signal. This signals are converted into text mode and again converted to the digital format which is can be understood by the device. After the digital signal transformation actual mathematical calculation has been takes place in the microprocessor of the calculator. The next part of the processor is to give output in the form of audio signal to the user. In the text analysis the result of the calculation is given to the user in the form of audio signals with the help of speaker mounted inside the smart number cruncher.

A smart number cruncher—a voice based calculator performs mathematical calculation with the help of text mode and audio or voice mode. These two modes are initiated to make calculation easier to the physically handicapped people as well as illiterate people. The hardware part of the traditional calculator will be as it is but along with that some part are added that speaker or microphone and some programming parameters to run the voice mode of calculation. This device is helpful to everyone in every field which requires calculator for mathematical functioning. As well as it is used in various electronic devices also. As it supports multiple languages, so user don’t have to worry regarding specific language. In this way Smart number cruncher is useful to everyone.

5. Novel feature & Analysis of smart number cruncher—a voice based mathematical calculator

Smart Number Cruncher, a voice based calculator used to perform complex as well as simple mathematical calculations based on voice mode. The hardware part included in the traditional calculator is speaker and microphone for input and output purpose. Another part will be handled by programatically. This system is helpful for many illiterate as well as physically handicapped people.

Table 1 shows technical analysis of regular traditional calculator and smart Number Cruncher. It defines the characteristics of Smart Number cruncher as compare to regular calculator.
Table 1. Difference in Regular calculator and Smart Number Cruncher Table

| Parameters                        | System          |               |               |
|----------------------------------|-----------------|---------------|---------------|
|                                  | Regular Calculator | Smart Number Cruncher |
| Text Mode calculation            | Yes             | Yes           |
| Voice Mode Calculation           | No              | Yes           |
| Easy to handle                   | Yes             | Yes           |
| Useful for handicapped people    | No              | Yes           |
| Affordable to user               | Yes             | Yes           |
| Human effort and customer comfort| Yes             | No            |

Table 2. Time saving while performing complex sums in traditional and Smart Number Cruncher

| No. of calculations | Regular Calculator (in seconds) | Smart Number Cruncher (in seconds) |
|---------------------|---------------------------------|-----------------------------------|
| 10                  | 100                             | 75                                |
| 20                  | 200                             | 150                               |
| 30                  | 300                             | 200                               |
| 40                  | 400                             | 250                               |
| 50                  | 500                             | 300                               |

Figure 8. Difference in time while calculating complex mathematical calculations
Figure 8 shows difference in time while calculating mathematical calculations. Smart Number cruncher saves time to calculate complex mathematical sums.

6. Advantage(s) of Smart Number Cruncher

- ‘Smart Number Cruncher-Voice based calculator’, which is useful for user to perform calculations.
- ‘Smart Number Cruncher-Voice based calculator’ does not require human efforts.
- ‘Smart Number Cruncher-Voice based calculator’ works on two modes text mode and voice or audio mode.
- ‘Smart Number Cruncher-Voice based calculator’ is not so expensive.
- ‘Smart Number Cruncher-Voice based calculator’ useful to common people to perform complex mathematical operations without any headache.
- ‘Smart Number Cruncher-Voice based calculator’ is easy to use/mount.
- ‘Smart Number Cruncher-Voice based calculator’ saves time to perform mathematical solutions.
- ‘Smart Number Cruncher-Voice based calculator’, Supports regional language.
- ‘Smart Number Cruncher-Voice based calculator’ Speed up calculations.
- ‘Smart Number Cruncher-Voice based calculator’, helpful for physically challenged people.
- ‘Smart Number Cruncher-Voice based calculator’ Reduce time required to search keys.
- ‘Smart Number Cruncher-Voice based calculator’ User friendly system since support multiple languages.
- ‘Smart Number Cruncher-Voice based calculator’ Use as normal calculator as key input is also supported.
- ‘Smart Number Cruncher-Voice based calculator’ uses voice as an input and gives output in the form of voice only.
- Smart Number Cruncher protects illiterate people from fraudulent people, who takes advantage of illiterate people.

7. Conclusion

Smart Number Cruncher-Voice based calculator, is a type of calculator used in various electronic devices to perform mathematical calculations. Smart number cruncher performs complex mathematical calculations very easily. The reason behind this is it having two modes of calculation that is text mode and voice mode. Text mode takes input, by pressing text or number or symbol and performs mathematical operations on the numbers, result of the operation is displayed on the display board. In the smart number cruncher along with this traditional way one more way of calculation is added known as voice mode. In the voice mode user have to select language to give input in the selected language, as user selects language user gives input in the form of speech. As user gives input and operation, smear number cruncher performs calculation and gives output in the form of voice mode. The best part of the device or calculator is user gives input in the form of voice mode and gets output in the form of voice mode only. Smart number cruncher is helpful for physically handicapped and illiterate people. This calculator is easy to use and affordable to common people. It is time saving application and used for complex mathematical calculations.

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