A Tribute to C Programming Language: History and Modern Applications

Priya Tyagi
MCA Student
Department of IT
Institute of Technology and Science (ITS), Mohan Nagar, Ghaziabad (UP), India

Chandra Mani Sharma
Assistant Professor
Department of IT
Institute of Technology and Science (ITS), Mohan Nagar, Ghaziabad (UP), India

ABSTRACT
C was first developed in 1972. It is now more than four decades since C programming has been popular among coders. C is said to be the mother of all modern programming languages and it paved the evolutionary way for various other modern programming languages such as C++, Java etc. C has a plenty of unique features that make it suitable for developing various applications in modern days too. This paper presents a chronological transformation of C language and discusses the niches of application development where it is still being used. There are various Application Programming Interfaces (APIs) and Libraries such as OpenCv, which are being used in modern day research and application development.

General Terms
Computer, Hardware, Programming Languages, Software Development etc

Keywords
Computer Programming, C, C++, Development in Modern Age, Swift, Hak etc.

1. INTRODUCTION
Hundreds of programming languages have succeeded C since its development in year 1972. Day in day out, new programming languages are appearing on the surface of software development. Interestingly, tens of programming languages have been developed in last 4-5 years and it becomes even more interesting to learn that in year 2014 itself, two new languages have been developed namely, Swift (introduced on 2nd June, 2014) and Hack (introduced on 20th March 2014). These two new languages seek more attention as they have been proposed by two giants of IT industry-Apple and Facebook. Swift is created by Apple and shares its genesis with Objective C but with some refined features. Hack programming language is created by popular social networking site company Facebook. Hack is identical to PHP but with fair dissimilarities. Table 1 presents the details of new programming languages developed in last five years i.e. during year 2010 to 2014. The fact of the matter is that 12 new significant programming languages have been created during the mentioned period. These programming languages come with some predefined objectives regarding application development such as web applications, mobile device applications, embedded applications etc. Markstrum[1] presents a historical review of various programming languages till 2010. His work mentions the impetus factors for developing new programming languages from a very early time. Kernighan & Ritchie [2], the developers of C, had a remarkable contribution in the modern evolution of programming languages. Then comes the contribution of Strousstrap[3], the developer of C++, who transmuted C in

C++ with inclusion of object oriented features such as class, object, encapsulation, polymorphism and abstraction. The modern day research in the field of developing new programming languages aims at addressing new issues and avenues of application development such as embedded systems, mobile applications, responsive interface development etc[4-8]. Further, recent advancements in the field of procedural programming and their evolution have been discussed in detail in [9] and [10].

Table 1: Some of the new programming languages developed in last five years (2010-2014)

S.N.	Year	Language	Developer(s)	Genesis
1	2014	*Hack*	Facebook	PHP
2	2014	*Swift*	Apple Inc.	C, Objective-C
3	2012	*Elixir*	José Valim	Erlang, Ruby
4	2012	*TypeScript*	Anders Hejlsberg, Microsoft	JavaScript, CoffeeScript
5	2012	*Julia*	Jeff Bezanson, Stefan Karpinski, Viral Shah, Alan Edelman	MATLAB
6	2011	*Ceylon*	Gavin King, Red Hat	Java
7	2011	*Dart*	Google	Java, JavaScript, CoffeeScript, Go
8	2011	*Elm*	Evan Czaplicki	Haskell, Standard ML, OCaml
9	2011	*Red*	Nenad Rakocevic	Rebol, Scala, Lua
10	2010	*Chapel*	Brad Chamberlain, Cray Inc.	HPF, ZPL
11	2010	*RPG Open Access*	IBM	FARGO, RPG,
12	2010	*Rust*	Graydon Hoare, Mozilla	Alef, C++, Camlp4, Common Lisp, Erlang,

C seems to be a strange name for a programming language but this strange sounding language is one of the most popular computer languages today because it is a structured, high-level, and portable language. The root of all structured programming languages is ALGOL introduced in 1960s that first used block structure. C is a programming language developed at AT & T's Bell Laboratories of USA in 1972. It

was designed and written by Dennis Ritchie. In the seventies C started replacing other familiar languages of that time and without any introduction it gained a great reputation and its pool of users grew. For many years, C was only used for academic environment support from commercial professionals. Later, with the release of many C compilers and the increasing popularity of Unix OS, it started gaining support from commercial professionals. Here is an example of very simple C program i.e. to print Hello World and Figure 1 shows the execution of this code snippet.

```
#include <stdio.h>

int main()

{

 printf("Hello world\n");

 return 0;

}
```


Figure 1: Execution of 'Hello World' program in C

2. ADVANTAGES OF USING C

C has gained immense popularity due to its many desirable qualities. It is a robust, fast and portable language.

There are number of advantages of C.

- **Procedure Oriented Language:** C language is a procedure oriented language. In this approach, the programmers use functions to execute perform various computation tasks. It follows top down approach for program development. It means that first main() method is written which calls various other methods. This approach makes it very easy to understand the logic of program.

- **A Rich Library Support:** It is true that original C has a very limited functionality and features e.g. the input and output mechanism was placed out of scope of core C functionality. The rationale behind this exclusion was to provide the flexibility in making C applications versatile. As I/O primarily depends of the nature of computing platform (hardware and software) and every platform has a different I/O mechanism. Nevertheless, C provides lots of functions that are in-built and can be used to develop any program easily. Further, programmers can create functions as per their requirements.

- **Speed of Compilation and Execution of Program:** A typical C compiler such as Turbo C produces machine code very fast compared to other language compilers. It is astonishing to learn that C

compiler can compile around 1000 lines of code in a second or two.

- **Steep Learning Curve:** C is said to be the mother of all modern programming languages. Even today, a programmer learns C first before learning any other programming language. C uses syntax that is very easy to understand like if, switch-case, loops, array, structure, union, and pointers. The learning curve of C is very steep and can be easily learned with less effort.

- **Portable:** Every C code is compiled into an executable file (.exe file), which is portable. It means that the code can be run on different versions of same operating system.

- **Compact:** C language setup is of meager 3-5 MB in size that can be easily transported in floppy or disk drives. To start writing C programs, very limited resources are required.

2.1 Modern Application Areas of C Programming

C programming is the only language which exists for such a long time and still it is being used successfully. It was developed in 1972 and it is used in 2014 as well, it is really a great achievement for a programming language called C. There are numerous applications of C in day to day life or in professional areas to create programs accurately. Some of these are as follows:-

- C is one of the most suitable languages being used for system programming. C has all the agility to interact efficiently with hardware. At the same time, it also provides ease for writing code from programmer's point of view. C language is used in writing Embedded Software.

- Firmware for various electronics, industrial & communication products which use micro controller.

- C is used in developing verification software, test code, simulators etc for various application and hardware products.

- C is used for creating compilers which can take input in different language and convert it into low level machine dependent language.

- It is used in implementing operating system operations.

- Unix kernel is completely developed in C language.

- There is a variant of C known as Embedded C. It is nothing but just a set of language extensions for C programming language by the C standards committee to solve the issues that exists between the C extensions for different embedded systems. In 2008, C standard committee extended the C language to address these issues by providing a common implementation for all to adhere which includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces etc.

- C is used in designing code for various games. The game programming can be done in C using various available libraries for graphics and GUI. Before

jumping directly to game programming one needs to know about event driven programming and the elements of game programming

- The real power of C vests in use of pointers. Pointers have various uses including writing viruses and other memory management applications. Pointers are undoubtedly one of the most distinct features of C language. A pointer is a derived data type in c. Even though, it appears little confusing and difficult for beginners,

- C is efficient in execution and is best suited for writing system software. System software directly interacts with hardware. User invokes the services of system software through application software. The code written in C easily get compiled into an executable machine code which as portable across platform.

OpenCV (Open Source Computer Vision): OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface.
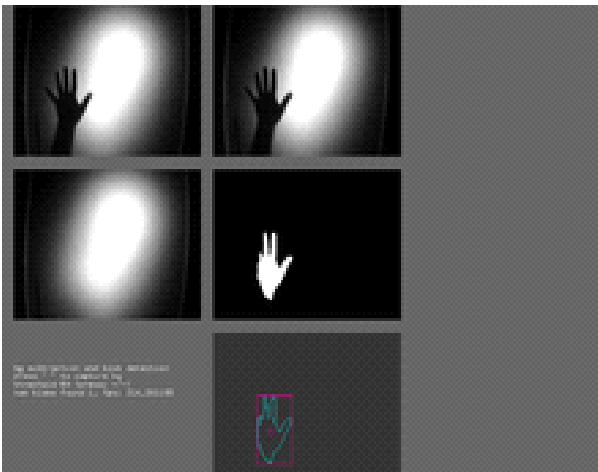

Figure 2: Open framework running the openCV

OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision, developed by Intel Russia research center in Nizhny Novgorod. OpenCv has several applications and some are listed below:

- Background segmentation in video and images

- Object classification

- Object tracking

- Object pose and action representation & recognition

- Motion analysis

- Machine learning

- Face recognition

- Human detection etc.

3. OTHER VARIANTS OF C
There are other variants of programming languages inspired from C such as:

3.1 C++
It is the true extension of C. The first name that developers of C++ gave to this was- C with Classes. C++ supports the Object Oriented Paradigm of programming. It was first developed in 1983 by Bjarne Stroustrap.

3.2 Embedded C
Embedded C is more suitable for hardware programming. It was standardized in 2008 to address various disparity issues. Although, Embedded C supports syntax and semantics of C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch, case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc. On the other hand, it takes into account the various features, those are not available in normal C like named address spaces, fixed-point arithmetic, and basic I/O hardware addressing.

3.3 Objective C
Objective C is used for writing iPhone applications. This competes with Java that is used in developing Android applications. Objective C can be efficiently and effectively used for developing applications that run on Apple devices. The latest variant of Objective C is Swift that has been recently created by Apple.

4. CONCLUSION
Tiobe's index, compiled each month, estimates the popularity of programming languages by the number of mentions they generate on the Internet. At Tiobe's top spot is the C language itself, accounting for just over 17.8 percent of the programming language references on the Web. After a decade of waxing and waning in popularity, the language supplanted Java last year as the world's most widely cited programming language. This paper presents a review on C programming language and its relevance & importance in modern age. It is aimed in future to elaborate new application avenues where C can be used as a language of programming and to delve into the latest breakthroughs happening in the arena of system programming.

5. ACKNOWLEDGEMENT

6. REFERENCES
[1] S. Markstrum "Staking claims: a history of programming language design claims and evidence: a positional work in progress." Evaluation and Usability of Programming Languages and Tools. ACM, 2010.

[2] B. W. Kernighan, D M. Ritchie (Author), "The C Programming Language" PHI Publishers, Second Edition, 1990.

[3] B. Stroustrap, "The C++ Programming Language," Addison-Wesley, Fourth Edition, 2013.

[4] S. Zhao, H U Shaohai, "Teaching Methods of C Programming Language Learned from Baby's Language Learning." Computer 8 (2011): 021.

[5] C. Zhu, C. Genlang. "Deeper Learning Cycle (DELC) Practiced in Computer Programming." 2014 International Conference on Education Reform and Modern Management (ERMM-14). Atlantis Press, 2014.

[6] M. Voelter, et al. "mbeddr: an Extensible C-based Programming Language and IDE for Embedded Systems." Proceedings of the 3rd annual conference on Systems, programming, and applications: software for humanity. ACM, 2012.

[7] M. H Egan, M. Chris. "Program visualization and explanation for novice C programmers." ACE. 2014.

[8] J. Cardoso, et al. "LARA: an aspect-oriented programming language for embedded systems." Proceedings of the 11th annual international conference on Aspect-oriented Software Development. ACM, 2012.

[9] D M. Simmonds, "The Programming Paradigm Evolution." Computer 45, no. 6, pp. 0093-95, 2012.

[10] G. White and M. Sivitanides, "Cognitive differences between procedural programming and object oriented programming", J. Information Technology and Management, *6*(4), pp. 333-350, 2005.