

# Free/Open Source Software and Health Care: Benefits and Challenges

Anu Gupta

**Abstract**— Health care occupies an important place in every country. Information technology (IT) can play a vital role to improve the quality, safety and efficiency of health care. But there are several hiccups in wide spread usage of Information technology in health care domain. In such a case Free/Open Source Software (F/OSS) provides an opportunity that allows the entire Internet community to use its combined programming knowledge, creativity and expertise to develop software, which could render benefits to whole community without involving cost and proprietary issues. The current paper outlines the general model of F/OSS development and highlights the features of few F/OSS products usable in health care. The benefits offered by F/OSS are very important in terms of flexibility, no licensing issue, negligible cost etc. These have encouraged organizations to adopt F/OSS products.

**Index Terms**— Free software, F/OSS, Health Care, Open Source.

## I. INTRODUCTION

Health care embraces all the goods and services designed to promote health, including preventive, curative and palliative interventions, whether directed to individuals or to populations [1]. In an efficient and effective health care system, large volume of information need to maintained and shared at local level as well at global level. Information technology (IT) has the potential to play a vital role to improve the quality, safety and efficiency of health care. There are several hiccups in wide spread usage of Information technology in health care domain like high cost, licensing, vendor instability and lack of customization. Free/Open Source Software (F/OSS) provides a viable solution to address many of these problems. F/OSS is software where source code is openly available generally at no charge. It is generally developed by geographically scattered large number of volunteers. F/OSS helps to bring down the cost of acquiring and developing software. It also facilitates to remove dependency on the vendor products and encourages the use of common data standards.

The origin of Free Software dates back to early 1980s with the foundation of “Free Software” (FSF) movement by Richard Stallman of MIT’s Artificial Intelligence Laboratory [2]. Stallman wanted to encourage development

of software that would enable users to access source code and make modifications [3]. The philosophy of the FSF movement has later been extended by proposing “Open Source” concept [4]. Open source software is encouraging software companies to release source code for their products [5]. So Free/Open Source Software (F/OSS) is a broad term used to embrace software that is developed and released under some sort of Free/Open Source license but all allowing inspection of the software’s source code.

Free/Open source licenses share two characteristics: the source code has to be made available and license fees are nil. The most common license is called GPL (GNU General Public License) [6]. It does not put any restriction on copying and further redistribution, but source code must be made available to the user. Modifications are allowed and derivative work has to be published under the GPL again. This makes GPL not very business-friendly. The FSF also offers the LGPL (GNU Lesser General Public License). This license allows commercial software to use F/OSS while diluting the conditions laid down by the GPL. There exists several types of licences namely Mozilla Public License, Apache Foundation’s licenses, BSD (Berkeley Software Distribution) license. The current paper outlines the basic of F/OSS development model and highlights some of F/OSS projects which can effectively be used in the health care domain.

## II. FREE/OPEN SOURCE SOFTWARE MODEL

The F/OSS projects are initiated and developed in very interesting ways. Generally a team comprising one or more developers develops a crude version of the software to solve some personal problem. This development team may keep the software to itself, sell the software under commercial terms or it may release the software as F/OSS. Last option will cost nothing to the development team, but some of the potential users might provide feedback and contribute to the development. Contributions can be in form of bugs’ identification, feature requests; or in form of translation requests, support requests etc. Most contributions will contain some sort of user insight which the development team might find useful. Several collaborative development sites exist to provide relevant infrastructure to host and manage these F/OSS projects. SourceForge.net, a collaborative development site currently supports the development of about 2 millions of F/OSS projects in diverse application domains [7]. Anybody can freely download and use the desired software. Some of the potential users might provide feedback and contribute to the development. Thus F/OSS phenomenon harnesses the collective wisdom, experiences, expertise and requirements

**Manuscript received May 25, 2015.**

**Dr. Anu Gupta**, Associate Professor, Department of Computer Science and Applications, Panjab University, Chandigarh, India, 09872065533. (anugupta@pu.ac.in).

of its most demanding users, thereby ensuring high quality of software products.

### III. GENERAL F/OSS USABLE IN HEALTH CARE

Many general purpose softwares are used in all the domain including health care like operating system, office automation utilities, web browser, email client, ERP (Enterprise Resource Planning) application etc. Today there is hardly any computer application with no corresponding F/OSS initiative. Apache is the most widely used web server in the world, with a significant market share [8]. It can be used on variety of platforms serving diverse range of web-based applications and user interfaces. Linux is a famous operating system kernel. Several large companies already use Linux and it is also used widely in hospitals. OpenOffice is the open source version of StarOffice, an office suite product from Sun Microsystems, similar to Microsoft Office. Mozilla is an open source project that includes majorly a web browser (Firefox) and an e-mail client (Thunderbird). MySQL is a relational database server used popularly across variety of domains. Different open source programming languages like PERL, PHP, Python etc. have also been developed, especially for dynamic web pages. Linux provides a credible alternative to MicroSoft Windows, while OpenOffice.org seeks to replace Microsoft Office. Mozilla's Web browser, Firefox, rapidly appropriated a large segment of Internet Explorer's market and the list goes on.

### IV. SPECIAL F/OSS USABLE IN HEALTH CARE

There are several areas in the health care where F/OSS applications can very well be utilized. A few of them are discussed briefly in the following subsections:

#### A. *Care2x*

Care2x is a very feature rich Hospital Information System that is fully configurable for any clinical structure to manage the administrative, financial and clinical aspects of a hospital [9]. It is built upon different modules which include e.g. in- and out-patient administration, admission, pharmacy, radiology, laboratories, ambulatories, nursing, DRG (Diagnosis-related group) etc.

#### B. *GNUmed*

The GNUmed project builds an open source Electronic Medical Record. It can be useful to anyone documenting the health of patients including doctors, physical therapists and occupational therapists [10]. It provides for Patient Handling, Medical Record management (like health issues, episodes, consultations, progress notes etc.), Test Results management, Document management, Staff handling, Appointment handling, Statistics, Reports and results visualization, use a DICOM<sup>1</sup> viewer to display CD-ROMs containing X-Rays, MRs, CTs etc.

<sup>1</sup> DICOM is Digital Imaging and Communications in Medical standard for distributing and viewing any kind of medical image.

#### C. *OpenEMR*

Open Electronic Medical Records (OpenEMR) provides for Medical Practice management, Electronic Medical Records, prescription writing, e-prescribing and medical billing application [11]. These programs are also referred to as electronic health records. It is an F/OSS replacement for medical applications such as Medical Manager, Health Pro and Misys. Major features of OpenEMR include electronic billing, Document management, E-Prescribing, Prescriptions (by printed script, fax or email), Insurance tracking etc. Calendar features include categories for appointment types, colors associated with appointment types, repeating appointments and the ability to restrict appointments based on type. There are customizable medical encounter forms, support for voice recognition software and electronic or scanned digital document management for records.

#### D. *RODS*

Real-time Outbreak and Disease Surveillance (RODS) aims to accelerate the development and deployment of syndromic surveillance by providing free software and catalyzing the formation of a development/ consulting community [12]. RODS is a highly modular system that adheres to the CDC's National Electronic Disease Surveillance System (NEDSS). The RODS system has modules that serve six major surveillance functions: data collection, syndromic classification, data warehousing, database encapsulation, outbreak detection and the user interface.

#### E. *CHITS*

The Community Health Information Tracking System (CHITS) is an extensible, modular, open source information system for rural health units [13]. It collects existing routine health data from vertical programs in the Field Health Service Information System (FHSIS) and integrates them into a unified, comprehensive computerized information system. Through CHITS, community-based health information is made available not only to public health agencies requiring community level information but also to the community itself which generates the information. It enables the community to use this information for local decision-making and health planning.

#### F. *Mirth*

Mirth is a unique healthcare information exchange and interoperable solution that integrates various Health Information Systems (Hospital, Clinic, Lab, Pharmacy, Radiology etc.), Legacy Applications, Databases, Protocols and Equipment [14]. Mirth supports an HL7<sup>2</sup> interface gateway that allows for message filtering, transforming, and routing.

<sup>2</sup> HL7 defines Standards for electronic interchange of clinical, financial, and administrative information among health care oriented computer systems.

### G. HIEOS

Health Information Exchange Open Source (HIEOS) enables secure health information exchange between various health communities, thereby enabling care providers to have longitudinal perspectives of patients' health records [15].

### H. iPath

iPath is an open source platform for telemedicine applications such as consultations, case discussions, virtual staff meetings etc. [16]. The core functionality is the "iPath-Server" with specialized modules developed on top of it. The most important module is a microscope controller, a combination of a client application for a remote workstation and a Java applet allowing controlling a microscope remotely over the Internet.

### V. BENEFITS OF ADOPTION

The FOSS movement is gaining momentum among diverse application area including healthcare and public administration organizations. Adoption of F/OSS offers certain benefits. Major benefits are discussed as follows:

- The collaborative nature of F/OSS development speeds the design of new systems. Rather than starting from scratch, vendors, hospitals and independent developers can tap into an existing body of tested software and tools. The ability to view and modify the source code offers more flexibility to the health organizations.
- By using shared software based on existing industry standards such as HL7 or DICOM, the interoperability of new applications is preserved.
- F/OSS has made it possible for government institutions to train their health workers on electronic health records at low cost. Without having to pay for software licenses, health workers now had the chance to learn the principles of health information management with no fear of breaking any proprietary agreements.
- F/OSS has reduced total cost of ownership, including maintenance, software customization and user training. It also tends to provide vendor independence.
- The geographically distributed large community of users and developers is available to help.

### VI. BARRIERS IN ADOPTION

There are also few problems in adopting F/OSS mentioned as follows:

- There does not exist any established quality criterion or model that can help to judge the quality, accuracy and completeness of an F/OSS project.
- There is always a fear that no vendor support may be available in case of failure or software errors.
- Most of the F/OSS software for a hospital infrastructure can be obtained free of cost, but customization and maintenance costs are also huge that small hospitals find hard to afford.

### VII. CONCLUSION

F/OSS has great potential to excel as every application is open from top to bottom making extensive customization and maintenance possible. By relying on F/OSS, health organizations can reduce the risk of getting locked into proprietary software and can reap the benefits of flexibility and wider options in future. But most of the health organizations find it difficult to choose appropriate F/OSS alternatives. For ensuring the increased use of F/OSS products in health care, it is important to create clearly defined quality models so that a prospective hospital organization can evaluate the quality of available F/OSS projects. Some common platforms are required for free and fair exchange of experiences and opinions among hospitals already using F/OSS products.

### REFERENCES

- [1] World Health Organization Report, 2000, "Why do health systems matter?"
- [2] Free Software Foundation, Available: <http://www.fsf.org/>
- [3] R. Stallman (1992), "Why software should be free", Available: <http://www.gnu.org/philosophy/shouldbefree.html>
- [4] Open Source Initiative, Available: <http://www.opensource.org/>
- [5] Eric S. Raymond, "The Cathedral and the Bazaar", Available: <http://www.catb.org/~esr/writings/cathedral-bazaar/>
- [6] General Public License, Available: [www.gnu.org/copyleft/gpl.html](http://www.gnu.org/copyleft/gpl.html)
- [7] Sourceforge.net, Available: <http://www.sourceforge.net/>
- [8] Netcraft Survey, Available: <http://www.netcraft.com/survey/>
- [9] Care2x, Available: <http://www.care2x.org/>
- [10] GNUmed, Available: <http://www.gnumed.org/>
- [11] OpenEMR, Available: <http://www.oemr.org/>
- [12] RODS, Available: <http://openrods.sourceforge.net/>
- [13] CHITS, Available: <http://www.chits.ph/>
- [14] Mirth, Available: <http://www.mirthcorp.com>
- [15] HIEOS, Available: <http://projectkenai.com/projects/hieos>
- [16] ipath, Available: <http://ipath.sourceforge.net>