MISA: AN OPEN SOURCE MOBILE INVENTORY SYSTEM FOR ANDROID

John Ezekiel D. Miclat
School of Library and Information Studies
University of the Philippines Diliman

Abstract

MISA is an open source mobile inventory software for Android devices which is a continuation of the thesis of the researcher. The said thesis was entitled: "Design and Implementation of an Open Source Android Mobile Barcode Inventory Software for the University of the Philippines Diliman School of Economics Library". The thesis aimed to produce a software which would be able to ease the process of inventory taking in the University of the Philippines – School of Economics Library (UPSE Library). The software was designed closely with the librarians and staff of the UPSE Library in accordance with the User Centered Systems Design (UCSD) framework conceptualized by Gulliksen et al. (2003). The researcher utilized The Rapid Application Development (RAD) approach as discussed by Kendall and Kendall (2011) as the development methodology of the software. For the frontend, the researcher used the Mobile Angular UI framework by Casimirri (2014) due to its user-friendly nature and responsive design. Existing barcodes in the materials were scanned using the ZXing Barcode Scanner mobile app by Owen (2014) to collect inventory data. To determine the operational benefits of implementing the software over the previously manual method, the researcher, with assistance of the librarians and the staff, conducted Time and Motion Study as discussed by Freivalds and Niebel in Niebel's methods, standards, and work design 12th edition (2009). After deliberating the results of the Time and Motion Study, it was determined that the software was able to improve inventory taking productivity by 54.1 percent.

Keywords: inventory, inventory control, library inventory, software development, time and motion study

Introduction

Inventory taking is essential to collection management because it determines which materials are present and which materials are unaccounted for (Lyle, 1961). Furthermore, it also improves the accessibility and consistency of the library records by identifying errors related to the library records. The reports generated by the process of taking inventory would enable librarians to amend errors and see to it that library records are coherent with the physical collection (Shouse & Teel, 2006).

Due to the intensive amount of manpower that inventory taking requires, it is usually done during vacation periods when user activity is usually minimum (Lyle, 1961). With reference to the state of libraries in the Philippines, inventory taking is still performed manually. During the internship of the researcher at the UPSE Library, the researcher had experienced manual inventory taking and found it lengthy and labor-intensive. According to Ms. dela Rosa, the UPSE Library houses an extensive collection of 101,961 volumes (September 2, 2014).

Utilizing the resources available in the library and recognizing areas for improvement in the current process for inventory taking, the researcher sought to create a software which would ease the burden of inventory taking in the UPSE Library without incurring monetary expenses. The existence of barcodes in library materials and the usage of Android smartphones by the librarians and library staff posed as a great opportunity for the researcher to exploit.

Software Design and Development

User-Centred Systems Design Framework

To ensure that the software would be able to respond and adapt to the needs of the librarians and library staff, the researcher made use of the user-centered system design.

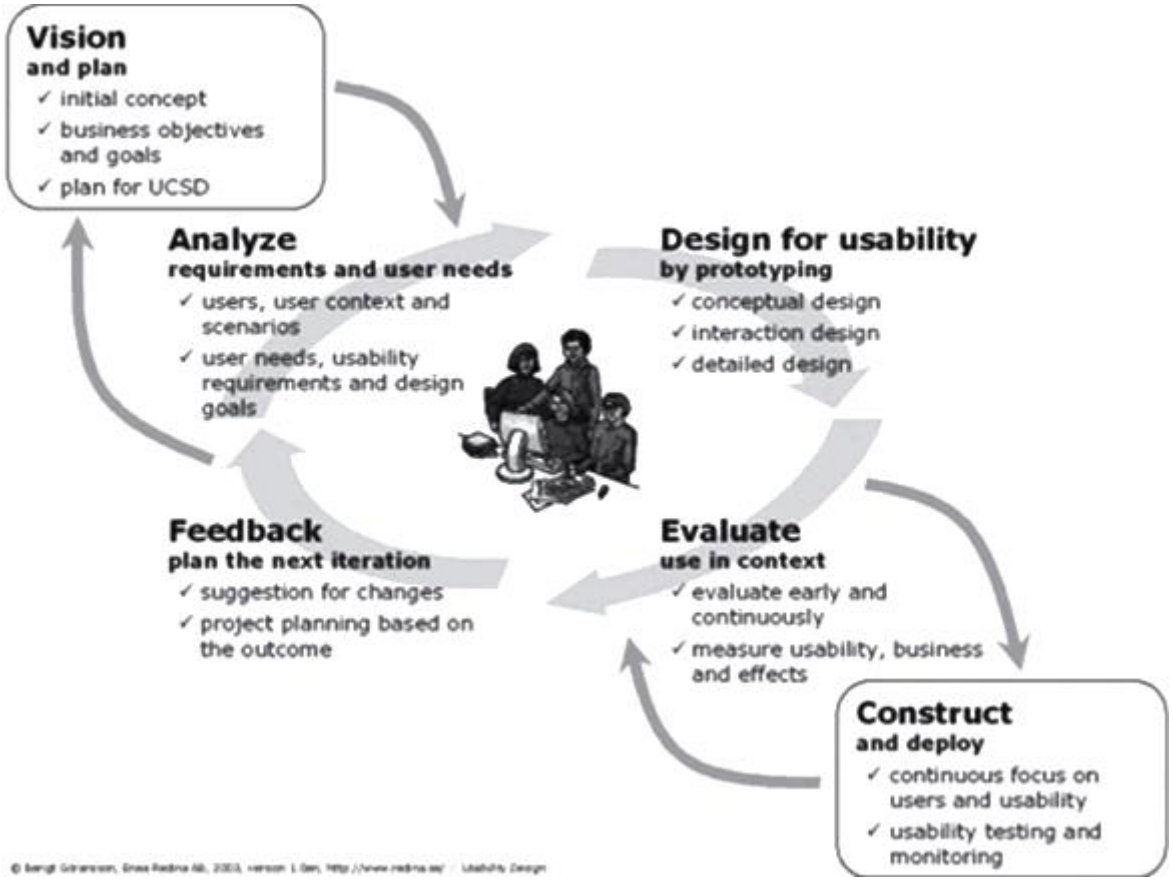

Figure 1. User-centered system design (UCSD). Adapted from "Key Principles for User Centered Systems Design," by J. Gulliksen, B. Göransson, I. Boivie, S. Blomkvist, J. Persson, and Å. Cajander, 2003, p. 401.

Rapid Application Development

After designing the software using the UCSD Framework, the researcher used the Rapid Application Development as the development methodology for the software due to amount of time available to the researcher and relative proximity of the UPSE Library. During the RAD design workshop, multiple prototypes have been developed closely with the librarians and library staff. By taking into account the inputs of the users, each prototype has undergone software testing to determine bugs, additional features, and usability improvements which will be either fixed or integrated into the next prototype.

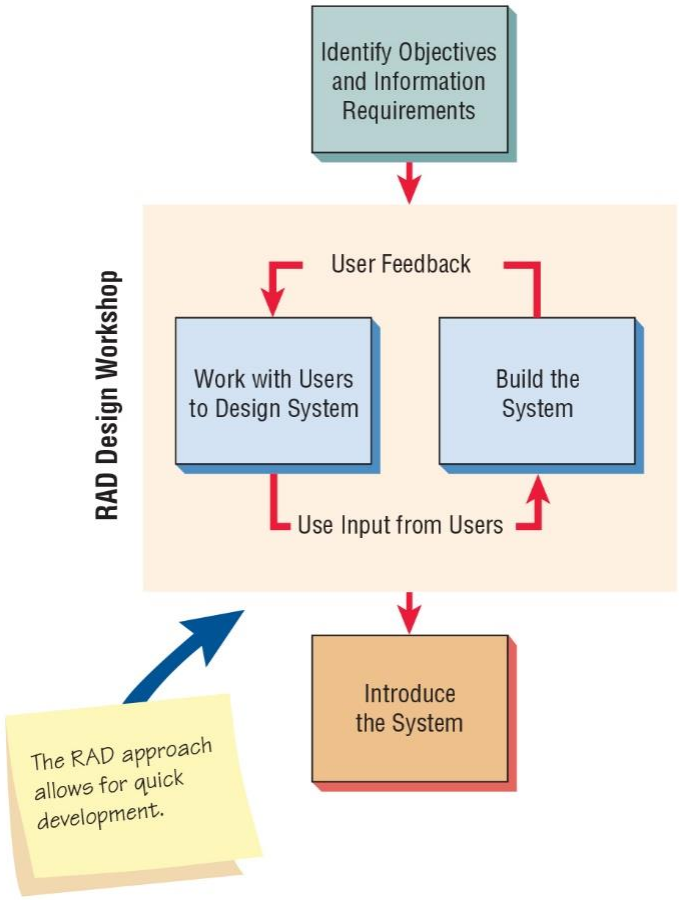

Figure 2. The RAD design workshop. Adapted from "Systems Analysis and Design," by J. E. Kendall, and K. E. Kendall, 2011, p. 165.

Implementation

In order to determine the benefits which could be derived from the implementation of the software, the researcher conducted Time and Motion Study of both the manual and automated inventory procedures. For both procedures, the stopwatch was started once the operator has taken the material, proceeded through inventory taking, and ended after the operator has put down the material.

Manual Inventory Procedure

In this procedure, the selected operator was Mr. Antonio A. Ativo, Administrative Officer of the UPSE Library, while the researcher took charge in timekeeping.

Figure 3 illustrates the output of the Manual Inventory Procedure which produced a histogram that is skewed to the right.

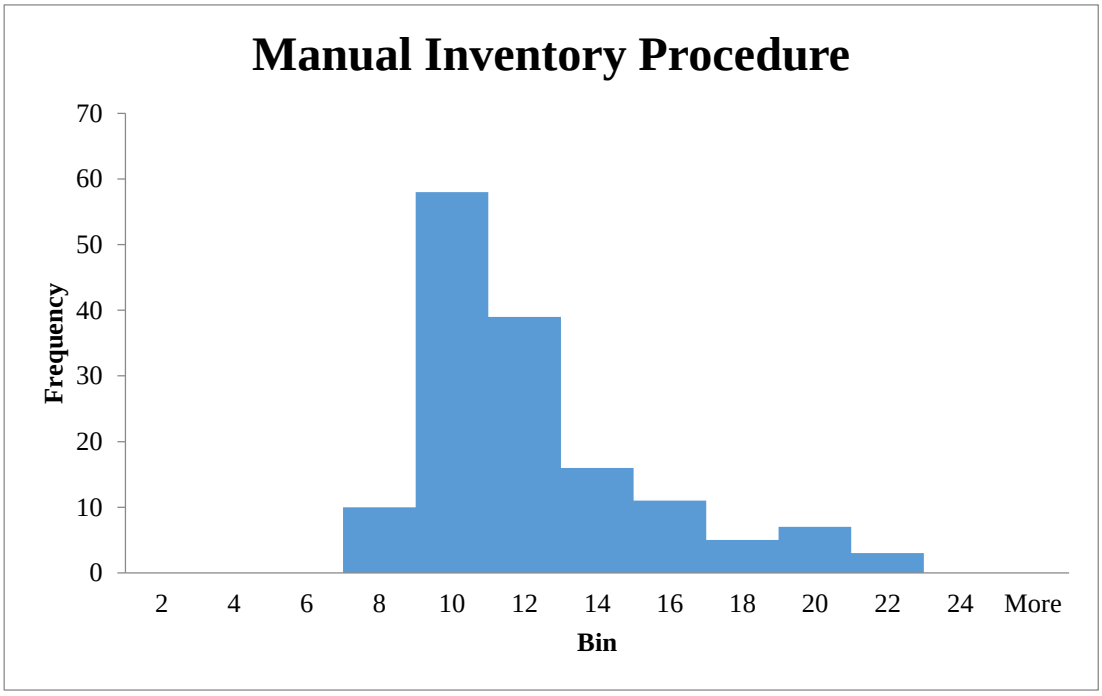

Figure 3. Histogram of the pilot testing. Adapted from "Design and Implementation of an Open Source Android Mobile Barcode Inventory Software for the University of the Philippines Diliman School of Economics Library," by J. D. Miclat, 2015, p. 60.

Table 1

Descriptive Statistics for the Manual Inventory Procedure

Manual Inventory	
Mean	**11.33512**
Standard Error	**0.259588**
Median	10.2
Mode	9.2
Standard Deviation	**3.168672**
Sample Variance	**10.04048**
Kurtosis	1.232728
Skewness	1.308515
Range	14.48
Minimum	**6.8**
Maximum	**21.28**
Sum	1688.933
Count	**149**
Confidence Level(95.0%)	0.512977

Note. Adapted from "Design and Implementation of an Open Source Android Mobile Barcode Inventory Software for the University of the Philippines Diliman School of Economics Library," by J. D. Miclat, 2015, p. 59.

Observations

While Mr. Ativo was performing the manual inventory procedure, there were a couple of inventory cards that clumped together. Also, there were some inventory cards which were improperly arranged. These issues led to delays which caused the graph to skew to the right.

Automated Inventory

For this procedure, the researcher acted as the operator while Mr. Brian Dayrit, Librarian of the UPSE Library, took charge of timekeeping. The researcher used a HTC One V Android smartphone, a TP-LINK TL-MR3420 Wireless Router, and a Lenovo ThinkPad X230i running Windows 7 Professional x64 for software testing.

Figure 4 illustrates the output of the Automated Inventory Procedure which produced a histogram which is almost normally distributed.

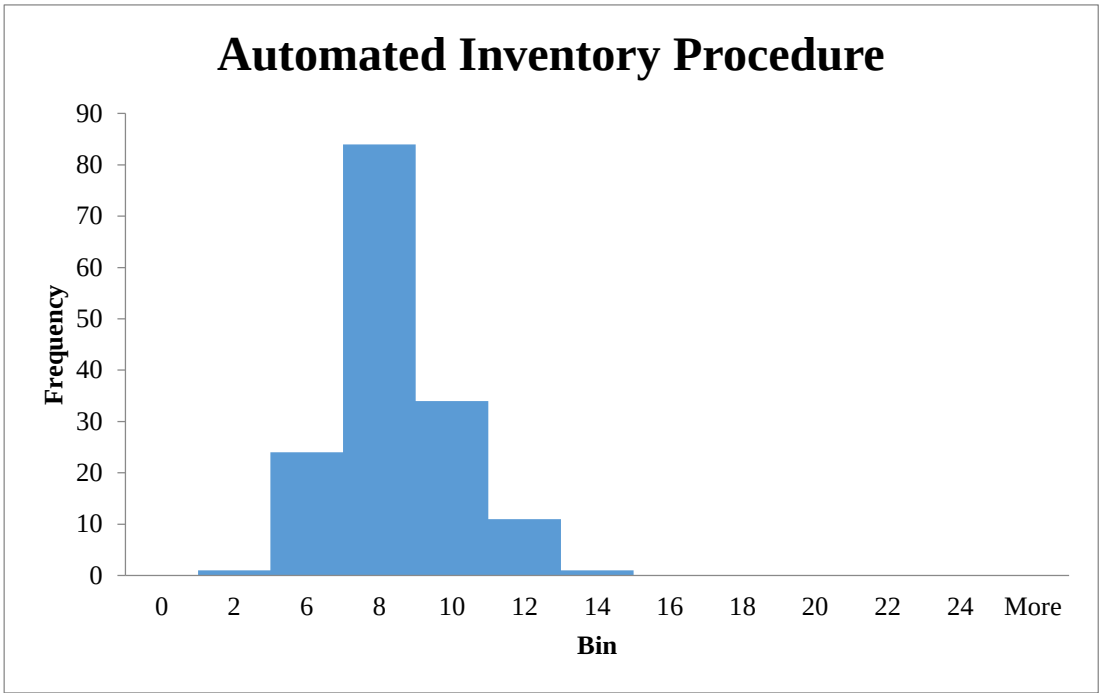

Figure 4. Histogram of the automated inventory. Adapted from "Design and Implementation of an Open Source Android Mobile Barcode Inventory Software for the University of the Philippines Diliman School of Economics Library," by J. D. Miclat, 2015, p. 64.

Table 2

Descriptive Statistics for the Automated Inventory Procedure

Automated Inventory	
Mean	**7.3552**
Standard Error	**0.131952**
Median	6.89
Mode	6.7
Standard Deviation	**1.642787**
Sample Variance	**2.698749**
Kurtosis	0.760427
Skewness	0.909582
Range	9.249
Minimum	**3.99**
Maximum	**13.239**
Sum	1140.056
Count	**155**
Confidence Level (95.0%)	0.260669

Note. Adapted from "Design and Implementation of an Open Source Android Mobile Barcode Inventory Software for the University of the Philippines Diliman School of Economics Library," by J. D. Miclat, 2015, p. 63.

Observations

In comparison with the manual inventory procedure, the automated was not affected by the presence of clumped or improperly arranged inventory cards. However, since the automated inventory procedure relies heavily on the camera of the smartphone, various issues related to image capture and barcode recognition arose during the test. There were instances when the camera could not take proper focus of the barcodes due to exposure overcompensation especially when the color of the material is too dark. With regards to mobility, the operating range of the smartphone is greatly influenced by the router and the onboard System on a chip. In terms of stability, there was an incident where the browser of smartphone crashed due to insufficient physical memory (RAM) which prompted a restart of the software.

Comparison of the Manual and Automated Procedures

After performing time and motion study and gathering data from both the manual and automated procedures, the researcher compared the means of the two procedures.

$$\bar{x}_{ST\ manual} = 11.33512$$

$$\bar{x}_{ST\ automated} = 7.3552$$

$$\frac{\bar{x}_{ST\ manual} - \bar{x}_{ST\ automated}}{\bar{x}_{ST\ automated}} \times 100 = \%\ difference$$

$$\frac{11.33512 - 7.3552}{7.3552} \times 100 = \%\ difference$$

$$54.1102546\% = \%\ difference$$

Performing statistical analysis on the data sets of the manual and automated inventory revealed that the implementation of the software improved inventory taking productivity by 54.1 percent.

Orientation and Additional Software Testing

Before the final release of the software, the researcher has conducted an orientation program with the librarians and library staff of the UPSE Library. On the first part of the program, the researcher introduced the tentative list of features and the graphical user interface. After that, a hands-on software testing was done to determine additional features or bugs which would be either added or fixed in the final release of the software. The Android smartphones used in this setup are the Sony Xperia Z C6603 (13MP Sony Exmor RS IMX135 Camera) and the Cherry Mobile Flare S2/Xolo Q700s (5MP Sony Exmor R IMX179 Camera). An Android tablet, the ASUS FonePad 8 FE380CG (5MP Camera), was also used along with a Gateway LT-Series netbook computer running Linux Mint 17 x64 LTS with an attached laser barcode scanner. The webserver used in this setup is an Intel Core i5-based custom-built PC running Linux Mint 17 x64 LTS. During testing, some barcodes were too small for the Cherry Mobile Flare S2 and the ASUS FonePad 8 FE380CG. Only the Sony Xperia Z C6603 and the Gateway netbook with a laser barcode scanner were able to properly scan and decode the barcode. This is primarily due to the lower resolution of their camera sensors. There were minimal issues with the normal-sized barcodes. Ambient light and auto-focus speed also influenced the success rate and speed of inventory taking. As for the software, the users discovered that there was no checking to determine if a material has been scanned already and the reports were not being generated properly. The software

issues mentioned here were fixed and duly tested again before the final release of the software.

Conclusion

The implementation of the software proved to be effective as it was able to improve inventory taking productivity by 54.1 percent over the previous method. It was determined that integrating inventory taking, report generation, and finding missing materials into a single software is indeed possible. Using Android smartphones, a web server, and a wireless router, the software was able to deliver a solution to help ease the process of inventory taking in the UPSE Library without incurring excessive monetary expenses on hardware or software. The possibility of scaling the productivity improvements is possible due to the ability to perform inventory taking simultaneously over different devices for as long as they are connected to the same network.

Improvements and Continuing Development

As a continuing effort to improve the software and add more features over time, the researcher has decided to further develop the software as MISA, a mobile inventory software for android. Over the past few months, the researcher has implemented a simple PHP script that automates the process of importing the starting database and creation of the database user to hasten and simplify the process of setting up the software. Also, the researcher modified the desktop scanning method to allow continuous scanning of materials without the need to refocus the cursor each time a material has been scanned.

Implementing and/or Contributing to the MISA Project

The researcher has made public the sources of MISA by virtue of the GNU GPLv2 license. The GitLab repository for MISA could be found here: https://gitlab.com/techkiel/misa

References

Casimirri, M. (2014). Mobile Angular UI - Angular JS Mobile UI framework with Bootstrap 3 Css. Mobile Angular UI. Retrieved October 24, 2014, from http://mobileangularui.com/

Freivalds, A., & Niebel, B. (2009). *Niebel's methods, standards, and work design* (12th ed.). Boston: McGraw-Hill Higher Education.

Gulliksen, J., Göransson, B., Boivie, I., Blomkvist, S., Persson, J., & Cajander, Å. (2003). Key principles for user-centered systems design. *Behaviour and Information Technology*, *22*(6), 401-403.

Kendall, J. E., & Kendall, K. E. (2011). *Systems analysis and design* (8th ed.). New Jersey: Pearson Education.

Lyle, G. R. (1961). *The administration of the college library* (3rd ed.). New York: H. W. Wilson Company.

Miclat, J. D. (2015). *Design and implementation of an open source Android mobile barcode inventory software for the University of the Philippines Diliman School of Economics Library* (Unpublished B.L.I.S. Undergraduate thesis, University of the Philippines Diliman, School of Library and Information Studies, Quezon City, Philippines).

Shouse, D., & Teel, L. (2006). Inventory: Catalyst for collection development. *Collection Building, 25*(4), 129-133.

Owen, S. (2014). Zxing/zxing • GitHub. GitHub. Retrieved September 9, 2014, from https://github.com/zxing/zxing