



Digital Validation Framework for Open Badges

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Master of Computer Science**

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2019**



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DECLARATION

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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ABSTRACT

Open Badge is very novelty concept in E-learning domain to motivate the recipients and it could be used as a symbol of the achievement in digital world. This concept is new to e-learning, but this concept is commonly using in a physical world such as Scouts are having badges. Once a person completed a task or a course, a digital badge will be awarded, and it could be used as symbol of achievement. If user gets this badge from well reputed institute/organization, it creates a value to him and could be used as a symbol of certificate.

So, this badge concept is implemented in IT industry and it is a one of the newest trends in E-learning. In digital world, this badge also a digital artifact and it uses web page which is link to the badge to show the details of the badge. However, there are several security threats in this concept in digital world such as it could be able to redesign digital badge with same look and feel, create a fraud web pages with fraud information and grant it to someone who has not achieved such. Then it decreases the value and trust of the original badge as well. People don't trust the digital badge due to this reason and the badge cannot be used for its purpose. People don't use badges even though it is expected to use. Hence it is a big need to find method to show the originality of the badge and It needs be validated in somehow to overcome above problem.

Therefor it is developed the solution to overcome above mentioned problems and this thesis is describing that solution. Further it discusses about how to validate and verify the open badge using existing and well-known technologies because, people who do validate this may or may not be an IT person. Hence It must to find out the most usually use techniques in today's world and wrap up our mechanism using it. Therefor it proposes a new way of bind information with digital badge and validate the digital details against it. so, it enhances the usability, reliability , security features and it opens the new ways of using it. Previously the Open badge should be used online only or else it is just an image. But with new concept, The Badge could be used in offline mode as well. Because information is bind with the badge itself. People can use it with the CV as an attachment. Nobody can steal the badge and create new badge, if some did it, it would be caught when they try to validate the badge.

This is a totally new idea and it will enhance the usability and open a new chapter of open badge in a future.

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TABLE OF CONTENTS

DECLARATION	i
ABSTRACT.....	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS.....	iv
LIST OF FIGURES.	v
ABBREVIATION.....	vii
1.0. Introduction.....	1
1.1. Problem Domain	1
1.2. The Problem	2
1.3. Motivation	3
1.4. The Exact Computer Science Problem.....	4
1.5. Research Contribution.....	4
1.6. Scope	4
2.0. Literature Review.....	6
2.1. Overview	6
2.1.1. Open Badge.....	6
2.1.3. Online verification	9
2.1.6. Badge generation via LMS	12
2.1.7. Motivation.....	13
2.2. Limitation	15
2.3. Research Gap.....	15
2.3.1. Comparison with existing solutions.....	15
2.3.2. Identified Gap	16
3.0. Methodology	17
3.1. Problem Analysis	17
3.2. Proposing Model/Design.....	17

3.3.	How does the new framework ensure the originality of the BADGE?.....	22
4.0.	Evaluation Plan	27
4.1.	Overall Verification of project	27
5.0.	Conclusion and Future Work.....	32
5.1.	Conclusion.....	32
5.2.	Future work.	33
	REFERENCES	34
	Appendix.....	37
	Appendix A – Project Plan	37
	Appendix B – Recipient Survey.....	38
	Appendix C – Issuer Survey	40
	Appendix D – To Evaluate Final Outcomes Of The Project	43
	Appendix E – Recipient Survey Result	46
	Appendix F – Issuer Survey Result	48

LIST OF FIGURES.

Figure 1:	earned badge Girl guide	6
Figure 2:	Digital Badges in Video Games	7
Figure 3:	Issued Open Badge	7
Figure 4:	Open Badge metadata.....	8
Figure 5:	Extended Validation SSL Certificate	10
Figure 6:	SSL certificate (Old) - No company Name	11
Figure 7:	QR-Code.....	11
Figure 8:	Notification when receive Badge	12
Figure 9:	Screenshot of Badge creation Moodle.....	13
Figure 10:	Basic concept – Motivation.....	13
Figure 11:	Maslow’s Hierarchy	14
Figure 12 :	High Level Diagram	18
Figure 13:	Badge with New Concept.....	19

Figure 14: Activity Diagram.....	20
Figure 15: Use Case Diagram	21
Figure 16 : HTTP vs HTTPS	22
Figure 17 : Certificate Details.....	23
Figure 18: Output compression.....	24
Figure 19 : Reading output	24
Figure 20 : output verified/banned.....	24
Figure 21: Shows Badge details online.....	25
Figure 22 : content of QR code.....	26
Figure 23 : Result for final Product	30

LIST OF TABLES.

Table 2-1: Compression of Existing popular system.....	15
Table 4-1: Result of Issuer & Recipient Survey for awareness	27
Table 4-2: Result of Issuer & Recipient Survey for Experience	28
Table 4-3: Result of Issuer & Recipient Survey about issue	28
Table 4-4: Result of Issuer & Recipient Survey for asking solution	29
Table 4-5: Result of final Product.....	30

ABBREVIATION

Issuer	Who Issue Open badge to Recipient
Recipient	Who receive the Open badges from Issuer
Viewer	Once Receiver receive the badge, it shows it to another party to show the achievement. This party is mentioned as viewer. He/she finds the reliability of the badge, if not reliable he/she will ignore the badge.
3 rd Party/ Hacker	This party will steal the original open badge and creates web page with same look and feel as original and fraud badge information. Finally grant it to someone who has not actually achieve it.
CV	Curriculum Vita

1.0. INTRODUCTION

E-Learning is one of the trending research area in IT domain. It is very useful and resource saving mechanism with high successive rate. Open Badge is a sub domain under E-Learning domain and it is used to indicate the success of achievement in digital world. This badge concept is a widely using technique in real world to indicate the achievement. Open Badges are facing some issues such as security, drop of the reliability and so on. So, this thesis discusses the new idea to overcome identified drawbacks in security/reliability and give additional features which will enable new chapter of Open Badge.

1.1. PROBLEM DOMAIN

This research project is based on verification of Open badges which is planned to be given to the student or the employee for their accomplishment of the given target, educational level or the experience level or etc. This thesis is under Open Badge domain and according to Open badge belongs to E-learning domain, this research project is belonging to the E-Learning domain.

1.1.1. Objectives

1. To find out the verification problems associate with current open badge technology.

It is doing the literature survey and identify the problems related to the verification category of the open badge concept in the industry.

2. To provide digital verification to the Open badges

Badges cloud be created by anybody. So fake badge also cloud be creatable. It is hard to identify the original badge among fake. Hence it needs to provide a verification mechanism which should be easy to use but hard to rob/copy.

3. To provide a digital evidence to data on Open Badge which cloud be reachable in online and offline.

It provides the digital evidence for the data incorporate with Open Badge. Badge is linked with online webpage which has details of badge. But it always needs to be in online. Hence you can share the badge in social media. But it doesn't

work when you are in offline. Hence this objective is to find out method to provide offline evidence to badge data. This enable to use badge offline.

1.2. THE PROBLEM

A 'badge' is a symbol or indicator of an accomplishment, skill, quality or interest [1]. It is something like a medal/certificate in real world, which army soldier gets, police officers get as well as Scout get when they complete the target. But these are the tangible artifact and those has some unique features to identify uniqueness and originality. The open Badge concept is developed based on the physical badge, but it has few other benefits than a real-world badge due to those are digital artifact. Open Badge is verifiable, portable digital badge with embedded metadata about skills and achievements. They comply with the Open Badges Specification and are shareable across the web. [2]

In today's world learning can look very different than traditionally imagined. Learning is not just 'seat time' in a school, but it extends across multiple contexts, experiences and interactions. Therefor students are engaging with various activities related to the course work. it is two types of skill and those are Hard Skills and Soft Skills. Hard skills are the technical expertise and knowledge gained. Soft skills are interpersonal qualities, also known as people characteristics, and personal attributes [3]. Badges are awarded according to the skills to the student.

The Open Badge is awarded to achievement in digital world. It is not easy to achieve badge and the issuer is responsible to the skill of the receiver. So, it is a proud, and receiver should be able to show it as the proof of their achievement. But the problem here is that how to keep trust on badge? The reason is Open badge is just an image and it act as a hyperlink (online) to web page which has information about the badge. But any hacker can steal the badge , create similar web page with scam information and give it to someone else who don't receive the badge in correct way. Then how the viewer (person who see your badge) understand/find out the original badge or keep trust on it? It is not possible at all because hacker can create very similar URL with very similar domain name to the web page with very similar look and feel. then it is hard to identify, and people don't keep trust on the badge at all.

As it is sharable digital artifact, it is necessary to provide verification for the badges and show, who does issue the badge and to whom does it issue and other most important information. but it should be correct. There are thousands of 3rd party fraud online hackers who will be acting as an original party and issue badges to others. This is the major concern when you are dealing with internet. It should have trust mechanism to verify the open badges or else what will happen is the validity and recognition of the open badges will be drastically decreased due to unreliability of it.

Badge is possible to share among social media using hyperlinks. URL and creating badges are based on the Technology. most of non-IT related people not know in and out of these technologies to identify the original and fraud. For an example, it says that using 'HTTPS' connections are more secure than 'HTTP' connection it is because 'HTTPS' connections are having the authentication of the owner. But it is possible to create similar URL with SSL certificate then it also acting as 'HTTPS' connection. If so it is not easy to identify the correct issuer by using this only. Because verifier don't know the exact issuer. As it mentioned above, this security threat is the major problem in this concept. Viewer don't want to put big effort to find out the badge is original or not. They simply reject of give value to badge. Hence, recipient also don't see much value on Open Badge because the current feeling of the badge is that the badge is useless , anybody can create such a badge and it doesn't reflect actual value of work.

Those are the major problems which this thesis is going to address, and it introduce a new framework to open badge to verify and validate Open Badges and give much more benefits than current situation.

1.3. MOTIVATION

Badges are the symbol of achievement. Hence Badges could be granted to anybody when they have accomplished some task or the experience level. So, originality and the reliability of the badge is the most important fact in this concept. If someone can create same looking badge and act as he/she got it for real talent. This is not ethical and illegal. Hence, People do not trust the badge and they don't give real value to badge due these reasons. Additionally, it has some limitations such as it needs to be in online all the time when use the badge and so on. Hence this research-based project is motivated by above issues to find out a solution to increase reliability, value and usability of Open badges in E-Learning in offline/online

1.4. THE EXACT COMPUTER SCIENCE PROBLEM

The most important computer science problem is how to give the digital validation/verification for the Open Badge and how to give cross verification mechanism in very simple way which could be able to understand by the IT and non-IT persons as well. Because if the system works in non-authenticated manner, it keeps to loop-hole for the 3rd party to publish same badge with look as same as the Original badge. It is violation. The limitation here is that it is not possible to stop issuing fraud badges by others and if you use open badge you always need to be in online or else you not able to see the details of open badge in current system. By considering all above issues, it needs to find a mechanism to give digital validation which could be used to ensure the originality and validate the badge in online and offline mode to increase the usability of open badge in offline as well..

1.5. RESEARCH CONTRIBUTION

It develops the software framework based on the new concept to validate and verify the Open Badge in E-Learning domain. This framework provides offline and online facility to do this verification. Further this framework could be used to any organization in any area with few configuration changes. According to this framework increases the security aspect of the open badge, it will enhance the reliability of using open badge than current system.

1.6. SCOPE

The proposed system scope is covering the complete framework for creating, issue and publish open badges. According this is a framework, this proposed system could be installed for any organization, institute or the university under their domain after few configuration changes. As outcomes of this project, it has a mobile application as well to do offline open badge validation, Responsive web application to manage(create, Update and Issue) Open Badges (Client Application) and Server Application which support for REST API support.

This Client application has some features such as sharing the Open Badge among social medias, manage Open Badges (creating, Update and Issue). Server application is the total back end application which has all the database and manipulation functions and the Client application is just and presentation layer application. Therefor it could be

replaced by any client-side application which has ability to call/read REST API of this project. There is another Mobile Application which do the validation of the Open Badge based on the QR Code on the Open Badge.

It uses two ways of give information about the Open Badge. First mechanism is already using in the industry and it is the Linked URL with Open badge which redirect you to the Open Badge store and give information about the Open badge and grantee. The second mechanism is the new concept which is proposed by this thesis and it does the offline validation of the Open Badge based on the QR code. The Code cannot be read by any QR Code reader due to the encryption mechanism which is used, and the decryption mechanism is only applied with this mobile app.

This proposed solution is not to prevent the creating fraud open badges. It is not possible in internet world. But this propose the mechanism to identify the original badge among any fraud badges which has been created by above mentioned framework.

2.0. LITERATURE REVIEW

2.1. OVERVIEW

2.1.1. Open Badge

A 'badge' is a symbol of an accomplishment, skill, quality or interest [1]. Therefore, it could be used to showcase what they have accomplished. This is what scouts are getting when they have done some valuable work such as president scout award. This concept could be applicable to any domain. [4]

Badges have long played an integral role in human behavior and [5]. Badges take on several meanings depending on their implementation and functions [6]. Usually a badge is a physical element which could be attached to the book, cloth or etc. for an example, Boy scout and girls guides in the scouting program earn badges for three things: progressing through the scouting program, attending a special event, or accomplishing a specific goal. They are given a badge or pin to wear on their uniform to show others what they have achieved [7]



Figure 1: earned badge Girl guide

This concept is using in military as well. So, soldiers have goals/targets to achieve Badges. Then they have accomplished the relevant task and achieve a physical badge. But today is in 21st century and people are digitized, therefore this awesome concept has been taken into digital world and it is been widely using in a video gaming, E-learning etc. The reason behind why these badges concept using in a video game is every video game loses its excitement over the time. Hence, they try to keep interest by building in challenges that provide you a reward for completing them. [7] It because to increase

the motivation level and let them to play the game with interest [8] [9]. In the online learning industry, a digital credential is often associated with a digital version of a traditionally paper certificate used to designate course completion or competency [10]. Hence E-learning apps also starts to use this concept and it increases the learner’s interest of following courses because they are awarded the badge once they have completed it. A “digital badge” is an digital record of achievements, tracking the recipient’s communities of interaction that issued the badge and the work completed to get it [1]. So, this commercially used digital badge concept with badge store was introduced by the Moxilla foundation and now it becomes the standard to use in e-learning domain as well. [11]



Figure 2: Digital Badges in Video Games

Learning is not just ‘seat time’ within schools in today’s world, it has been extended among varies contexts. It is no longer just an isolated or individual activity. Education is inclusive, social, informal, participatory, creative and lifelong [1]. The Traditional Class room concept has become online classroom. It has offered multiple pathways to gain competencies and refine skills through open, remixable and transparent tools, resources and processes. In this connected learning ecology, the boundaries are broken, and the walls are down — now we just need to help it reach its full potential [12].

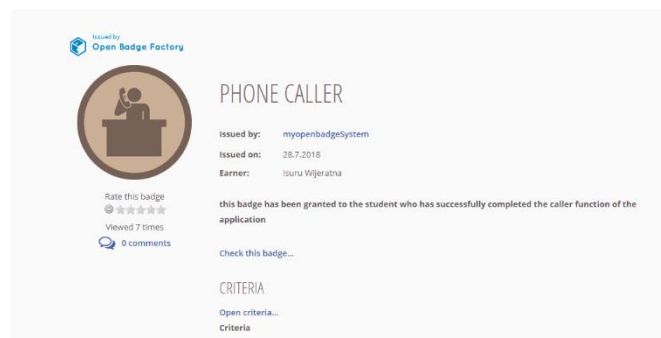


Figure 3: Issued Open Badge

A digital badge is an image with a range of ‘built-in’ information or metadata. This metadata is added to a badge by the issuing system, and includes details such as a description of the badge, the issuer and recipient of the badge, the criteria for earning the badge, whether the badge expires etc.



Figure 4:Open Badge metadata

Over the past few years, many trade publications and academic institutions have highlighted employer’s concern toward employee preparedness to the job market. Employers are seeing disconnect between what employees are learning through academic as well as professional avenues and what the employers need in their employees. Job-related skill verification is often a time-consuming and hard process for employers to do [13] [8]. Furthermore, in many situations’ employees have taken a more informal learning approach and employers’ question whether Are applicants skillful to succeed in the business? So, this Open badge are very important in these situations is because that present an opportunity to capture information about the learner’s knowledge and skills and display them in a way that employers can easily recognize and acknowledge their values and capabilities. A digital badge serves both as recognition of learning or achievement AND digital proof of that accomplishment [10].

2.1.2. What is verification/security

digital verification is the protection of this online assets. Criminals are finding new ways to operate and steal information from digital world for their own personal gain. Digital verification is an all-encompassing term which includes the tools you can use to secure originality of identity, assets and technology in the online and mobile world.

2.1.3. Online verification

Verification means the process of establish a validity of something. This is one of the major problems in the internet assets. Anybody in internet can produce any thing and publish. For an example, Institute 'A' creates a Badge to their student and award it for some achievement. There may be another institute which creates same badge (an identical copy) and awards it to student who want to show that they have complete the task of Institute 'A', but they have not. Finally, all have same badge (copy and Original). It is very hard to other users to figure out what is the Correct/Original or what is fraud. It is unfair. Correct person who has achieved in a proper way will get loss feeling due to this. There for it is mandatory to give verification to the Open Badge. According to those are online assets and as it says that "Internet's founders did have security concerns. "We knew that there were untrustworthy people out there, and we thought we could exclude them" [14], it should provide a verification to it.

Information related to digital badge is published by using the URL. So, the one way of providing the verification is to bind the SSL certificate with the URL. Hence the URL has the information about the original owner of the domain. but 3rd party hacker also able to get the SSL certified URL and create badges. Only different is that hacker wont able to get Original certificate which Original party is using and original URL. So, using SSL certificate also a good idea but hacker able to create URL with SSL certificate which is not exact but much more like original. Further non-IT people doesn't know how to get company details from the URL and verify the originality.

2.1.3.1. *How to digitally validate the URL*

According to the number of users of using the internet are increasing, there may be some criminals who spend more time on exploit internet vulnerabilities for fraudulent gain. Due to Internet is not designed with security in mind initially, it should provide the such a mechanism forcefully to continue the usability, reliability of transaction over the internet.

Attaching a Digital Signed Certificate with the URL will provide the world class unique verification about who is the true owner of the given URL. This Digital certificate are Issued by the valid certificate authorization and then we can confirm that the digital certificate will provide authentication, reliability and the public trust for the URL. [15] Those Certificate is called as SSL digital signed certificate. There are three types of certificates.

- Domain Validated: certificates offer the least amount of assurance about the holder of the certificate. Owner just want to provide the facts to ensure that they have right to use domain only. These type of SSL certificates does not provide guarantee about who that owner is.
- Organization Validated: This type gives additional assurances about the holder of the certificate the gives confirmation of their ownership of the domain.
- Extended Validation: these certificates are issued only after the applicant can prove their identity to the satisfaction of the CA. The screening process includes verification of the existence of the requester applying for the certificate, verifying that identity matches official records, verifying that the entity is authorized to use the domain and confirming that the owner of the domain has authorized the issuance of the certificate. So CA has all the information of the issuer.



Figure 5: Extended Validation SSL Certificate

This Extended validation certificates are the new version of SLL certificate. This provides more information than previous SSL certificate such as company names etc. and both previous and new certificates are working as same in security.

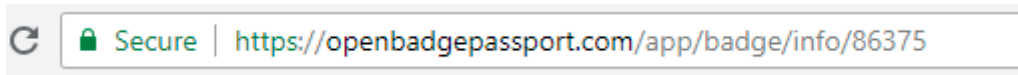


Figure 6: SSL certificate (Old) - No company Name

There for these new Extended validation certificate will provide more verification, identification and the public trust.

2.1.4. Embed data with QR code

QR code is an abbreviation of Quick response code which means it is very effectively and quickly readable by using today's smart phones or QR code readers. It is not in human readable format and it is possible to encode very large amount of data. Barcodes are used in early days and it is 1-Dimensional barcode. But QR code is 2-Dimensional, Matrix typed barcode. This is trending technology in an industry due to easiness of use. However, this also has few drawbacks such as user need specific readers to be downloaded to the mobile App to read the QR code or barcode, lack of awareness about the QR code etc.



Figure 7: QR-Code

2.1.5. Encryption Mechanism to encrypt data and create QR Code

It has been used the encryption mechanism to do encrypt the data before creating the QR code because QR code is a common technology and there are a lot of QR Code reading applications are available. There are a lot of mechanisms to do data encryption such as Base64 encryption, Key based encryption, RSA encryption mechanism [16] and so on. it uses data encryption mechanism based on Base64 encryption with application own algorithm. Hence that encrypted string is possible to decrypt only by using the mobile app which know about this decryption algorithm. If the given string in QR code is generated by this system it shows the correct information of the badge

which are shown in a web page which is linked to the badge and if the string doesn't support to the algorithm, it gives the Banded sign as well.

2.1.6. Badge generation via LMS

LMS is an abbreviation of Learning Management System. LMS is a software-based platform that has an ability of managing the course materials, administration, documentation, tracking, reporting and delivery of e-learning. According to these Open Badge concept also a value-added feature in E-learning, this has been embedded to some e-learning management tools such as LMS.

There is some software solution such as Moodle which has this feature, but it has limitations. Cause creator or the teacher in charge of the course could be able to award an open badge to the student in manually or at the end of the certain criteria. Therefore LMS and the Badge awarding process has some integration based on the user activity. There are some criteria's to be met to award open badge to the student. These criteria have been taken from the Moodle software solution. [17]

- For course badges, the criteria are: Manual issue by role; course completion, activity completion and previously awarded badges.
- When selecting Manual completion by role, you can choose the role you wish to award the badge, so for example a teacher could allow a non-editing teacher to award badges in the course.
- For badges to be awarded for course or activity completion, Completion tracking must be enabled in the site and the course.

Therefore it will award or revoke the mistakenly awarded Open Badge. Further some solutions like Moodle has advanced integration with some widely used portfolio solution such as MAHARA. Those integration is only to display the Badge without shared link. [18]

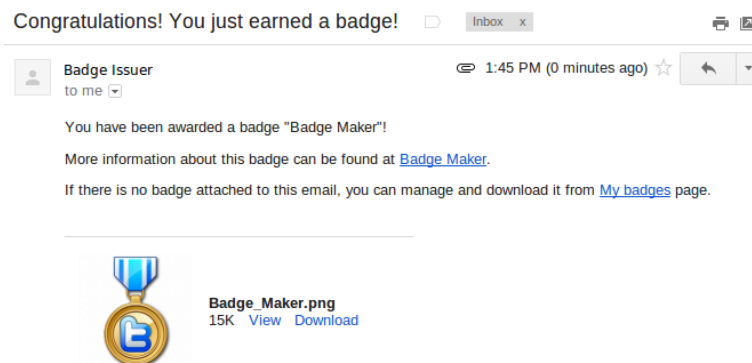


Figure 8: Notification when receive Badge

Above notification Figure 7 will be received when user received the badge from Moodle. These kinds of tools are getting some information commonly and embed. But that information is not enough to give the high security and verification.

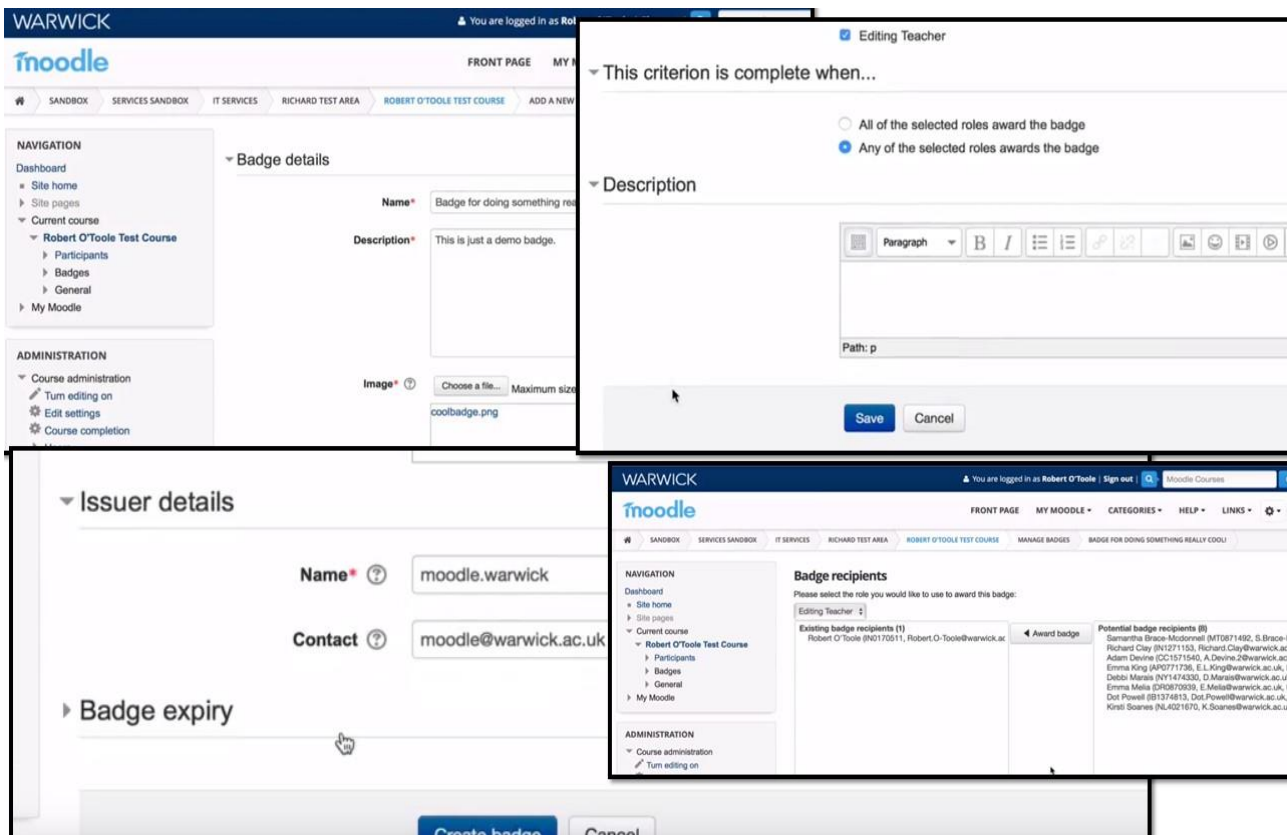


Figure 9: Screenshot of Badge creation Moodle

2.1.7. Motivation

Motivation is probably the most important factor that educators can target to improve learning. It encourages the student to do study well. So, it is very important to define and do motivate students to achieve more targets.

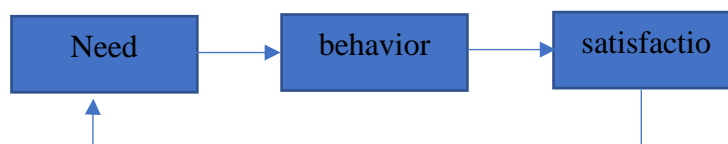


Figure 10: Basic concept – Motivation

This figure displays that you have certain needs or wants, and this causes you to do certain things (behavior), which satisfy those needs (satisfaction), and this can then change which needs/wants are primary (either intensifying certain ones or allowing you to move on to other ones). Adapted from “Introduction to Organizational [19]. Here we

can enhance above diagram by adding “reward” box in-between behavior and satisfaction. This is what the point of view of the experimenters on this area and the managers. So, this reward element will be replaced by awarding badges to them.

Additionally, the theory Maslow’s Hierarchy of Needs Theory is one of the most well-known motivational theories. Abraham Maslow’s theory identifies five levels of hierarchical needs that every individual attempt to accomplish or conquer throughout one’s life. The needs start with the physiological (hunger, thirst, shelter) and then move upward in a pyramid shape through safety, social, and esteem needs, to the ultimate need for self-actualization. [20] Below diagram graphically represent the Motivation theory.

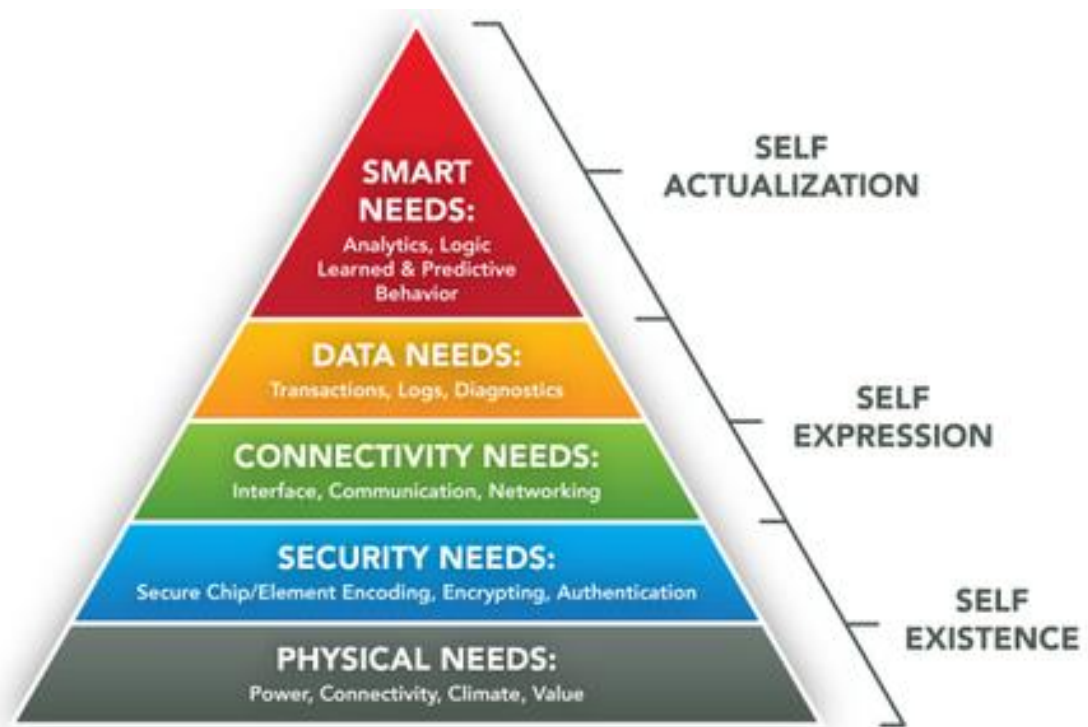


Figure 11:Maslow’s Hierarchy

Hence it uses badge to motivate the student and show the next target. Finally, it will motivate the student to achieve life target in education and any field.

2.2. LIMITATION

This is a research-based project. As this is online digital badge related project, this has below limitations.

1. It has been introduced a new concept to manage and verify Open Badges in online and offline only
2. This proposed system is not an alternative for the online e-learning (LMS) or online content management system

2.3. RESEARCH GAP

2.3.1. Comparison with existing solutions

There are few open badge management systems which can reward open badges to users. Some of them such as “MAHARA” and “Moodle” is widely using software Solution in education sector. Here it has mentioned the comparison of some features.

Table 1.6-1: Compression of Existing popular system

Compression of Existing popular systems

	MAHARA	Maxilla open badge1. 0	Moodle/Open Badge factory	Open Badge Passport	My proposal
Create Badge	✗	✗	✓	✗	✓
Open badge collection	✓	✓	✗	✓	✓
Share Open badges with Social media (Facebook/linked in)	✗	✗	✗	✓	✓
Create customized badges for the defined achievements	✗	✗	✓	✗	✓

(Published by the universities)					
Support t modern UI/ UX	x	x	x	✓	✓
Propose new target based on experience	x	✓	x	x	✓
Digital verification for the badges.	x	x	x	x	✓
Issuer level verification	x	x	x	✓	✓
Create unique badges according to the issuer	x	x	x	x	✓

2.3.2. Identified Gap

Open badge management system which is currently published based the research which has been done by Maxilla, they highly looked about how those are published and share, how those are integrated with well-known LMS systems etc. I am going add additional feature to the lacking problem of Verification of Open Badges. So, in this research proposes the new simples and concreate concept of how to provide the online/offline verification on the Open badge using existing technologies.

3.0. METHODOLOGY

3.1. PROBLEM ANALYSIS

Open Badges are the existing concept and it has been using in an education field as well to encourage and motivate the people. So, it is playing superb role on motivation and encouragement. According to the research, the sight on the Open Badges is from the verifier's side. It has done the thorough investigation on what are the existing technology related to open badges, how it proves the validity of issuer and so on. These things have been done on Literature survey.

Open Badges are designed as a symbol of an accomplishment, skill, quality or interest [1]. As it is a digital artifact, recipient abeles to publish or show it to others. What does the badges doing is that it says the audience that the recipient has accomplished something? It acts as a fact for it. Audience may or may not have sound IT knowledge and may or may not have experience using smart phone. therefor the solution should be very simple and easy to use but it should give the solid verification on the badges.

In current and mostly using mechanisms to creating open Badge are the "Mahara" Open Badge foundation". The mechanism which is using is that they are created the separate web page with badge information and bind it with the image as hyperlink. So, if the user clicks on the badge, user will redirected to the page with has badge information such as the university (Issuer) details, expiration information, Recipient details and so on. But anybody who has IT knowledge can do this and they can issue fraud badges which looks same as original badge. There is no simple way of identifying the originality of the badge. hence, we are looking for the same concept with solid verification to Open Badge and it gives easy verification mechanism to end user to make sure about the issuer.

3.2. PROPOSING MODEL/DESIGN

According to the new proposed concept, it creates the framework which can use by any organization and keep the own badge issuing facility. when it is published on the internet, it is usually another URL. we are proposed to have SSL certificate to all the organization who use this framework as current system also using SSL certificate. Then It adds the institutional/organization level information on the URL and they can use the subdomain of the university or institute to give more value and increase the reliability of using the URL. These certificate clouds be able to purchase from the Certificate

Authorities by providing correct and valid information about the organization. Then It shows the URL in ‘HTTPS’ protocol and web browsers are showing it in green colour. This ‘HTTPS’ concept is more popular among the IT and Non-IT people due to most of the people are purchasing goods from the internet by providing credit card details.

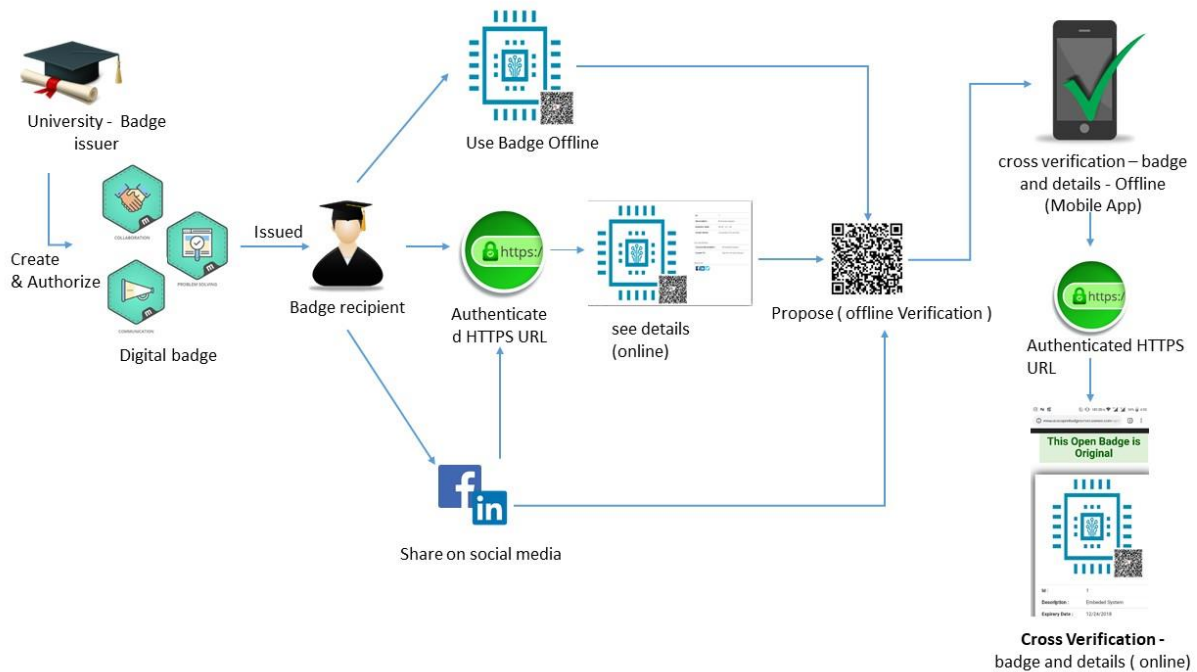


Figure 12 : High Level Diagram

According to the High-Level diagram, It is not the only verification method which use in this framework. Normally when user receive the Badge from the Open Badge Foundation they mentioned their name as issuer. But for more validity, it should have the institutional level information with badge. So, end user able to add this information at initial configuration stage so those information use when creating the badge. As it mentioned earlier, all end users could be able to reach to URL which belongs to institution own domain and it shows badge details and be able to verify the badge. So, this verification could be done online when Person click on the URL. This provides more confident to 4th party (viewer) about the badge and issuer/recipient.

Sometimes, when recipient use the open badges without internet facility, there is no way to do online verification. Such as recipient use the print out of the open badge. There is no way to verify the badge is original or fraud. Then it becomes a just an image, sometimes that image may be only proof of the work he/she has done. By concerning this situation, it proposed the offline verification mechanism which comes as Smart

phone App. Why it plans for the smart phone is because, all the higher management is using latest smart phones to check mails and so on. So, it is familiar device among the target crowd of this. Then it creates the mobile application to read the data on the Open badges and show. For an example, the recipient may mention the Open badge is for the “100m Running Event” of the ‘ABC’ school in 2017. So instead of what recipient mentioned on the CV or the post, reader can read the data on the Open Badge and get the information directly. This could be done when you are in online as well. Because hacker can create similar environment which is hard to identify.

As a benefit of this, it is not an easy for the hackers to create same badge and published if the hacker gives wrong information and copy the original badge, there is a contradiction with the details of the badge itself and the linked web page. So, copying is not possible to do with this solution.

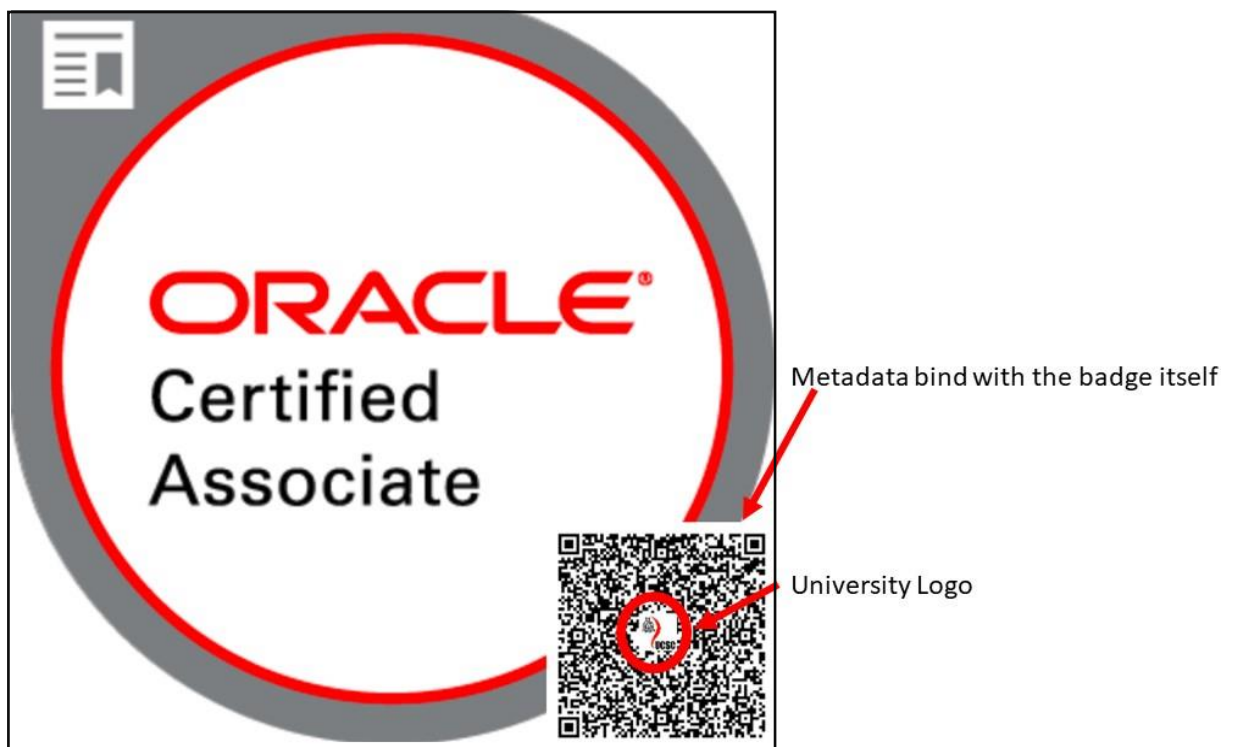


Figure 13:Badge with New Concept

According to the process, it shows the activities which involves with full process.

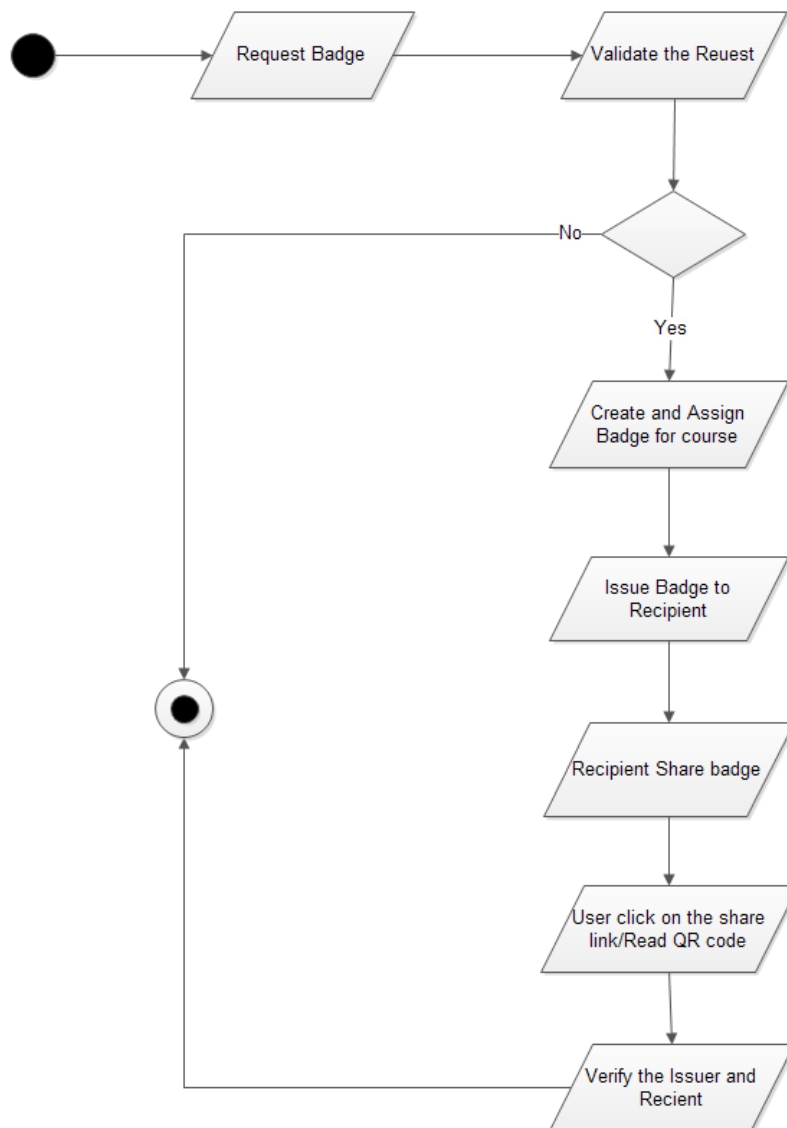


Figure 14: Activity Diagram

It has been identified 4 rolls of the system. Those are

Admin : who able to create the badge and add information about the badge,

Issuer: who can request the badge and issue badge

Recipient : Issuer grant badges to these type of users

IT/NON-IT user : these type of people and looking for the verification of the given badge to recipient.

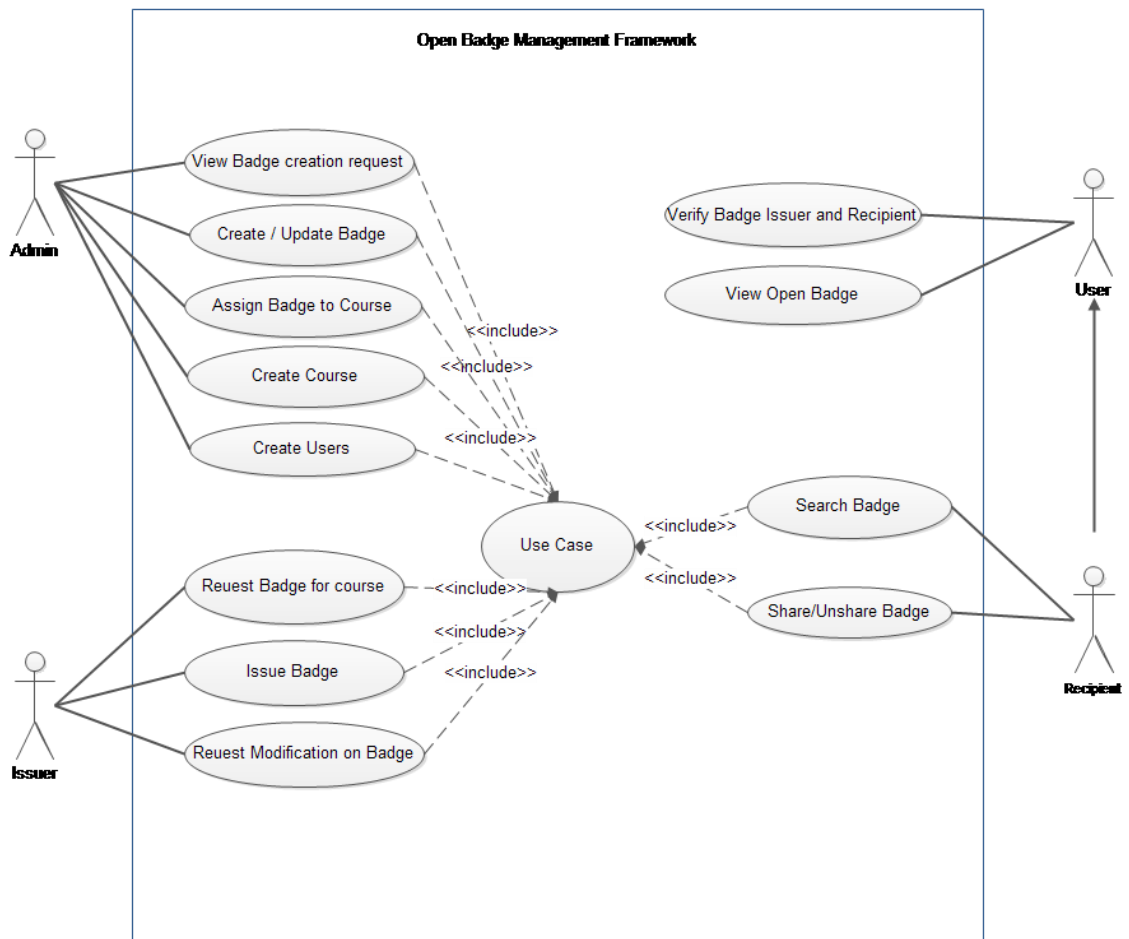


Figure 15: Use Case Diagram

Hence this research-based project will be result with Open Badge management framework with Verification and the smart mobile client application which runs on Android to do verification of the badge in offline mode.

3.3. HOW DOES THE NEW FRAMEWORK ENSURE THE ORIGINALITY OF THE BADGE?

Verify the Originality of the Badge means it should support the evidence to identify the given Badge is Original or Fake. Because some hackers create the very similar open badge and use to show it as original. This same misbehavior happens to the usual certificates as well. If there is no way to identify the Original certificate or Badge, it creates the room the fraud people to do such work.

According to Open Badge is digital artifact, it is easy to do fraud thing because it is not tangible, and anybody can copy/create fake badge looks as original. Normally people don't keep the URL in mind. They keep the organization name. Especially, Non-IT people doesn't worry about this. if the URL has words equal to organization, they think it is the URL from the Organization. People don't think and keep in mind about URL type. It doesn't matter that the URL is ".lk" or ".com" or any. Hence those fake organization use this and create very similar URL. (E.g www.abc.lk and www.abc.com). People normally don't remember the Top-level domain.

3.3.1. Use HTTPS instead of HTTP

This is most powerful technology to show the trustworthiness in the internet world. Each browser shows the trust symbol when the URL is HTTPS configured. It is not possible to get same SSL certificate which Original organization is using. It should provide the information about the organization and pay money to get those SSL certificate. This ensure the organization is original.



Figure 16 : HTTP vs HTTPS

Then End user can open the SSL certificate from the browser and see the URL which show the Open Badge Details is Original or Fake.

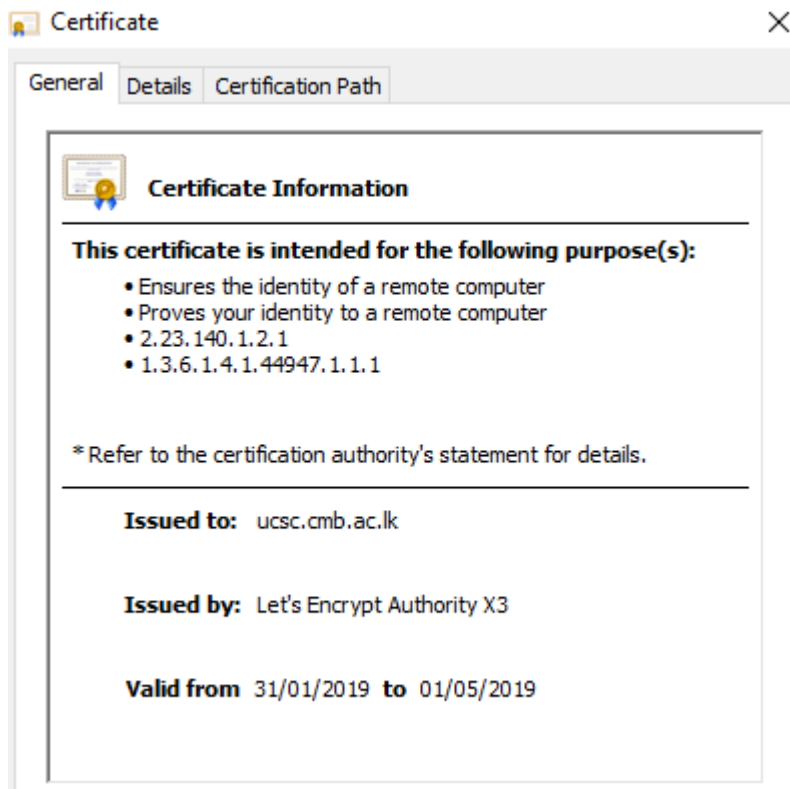


Figure 17 : Certificate Details

The current Open Badge world also using this technology to make trust with end-user. But IT people are familiar with this and non-IT people doesn't. Hence most of the people doesn't open the URL and see the details. They have idea about Figure 15. If they know this HTTPS concept, they check only that green colour locker. But if URL has the SSL certificate, they also get this Green colour locker. Hence it is not the enough evidence to make sure the originality of the badge.

3.3.2. Proposed framework and method

I introduced new idea to ensure the originality of the badge. According to final badge is publicly available and it should give support to anybody to use without additional training specially for non-IT people, idea should be implemented by using existing technology and it should not do any effect to the existing badges. The only things what new idea should do is to provide better verification and add additional value to the badge.



Normal Badge – output of existing system



New Badge – output of this framework

Figure 18: Output compression

Output of this framework binds the New QR code with organization logo to the Badge. It doesn't do harm to the badge and it give richer look and value to the Badge. This QR code consist the information about the Issuer, Recipient course details etc and the button to go to badge details page in online

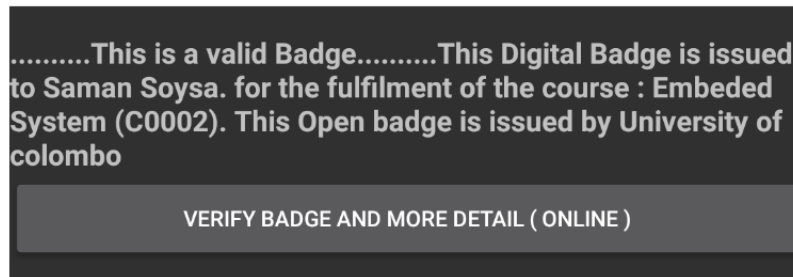


Figure 19 : Reading output

in addition to above details, it clearly shows that the badge is verified or not by showing the image clearly. See figure 20.

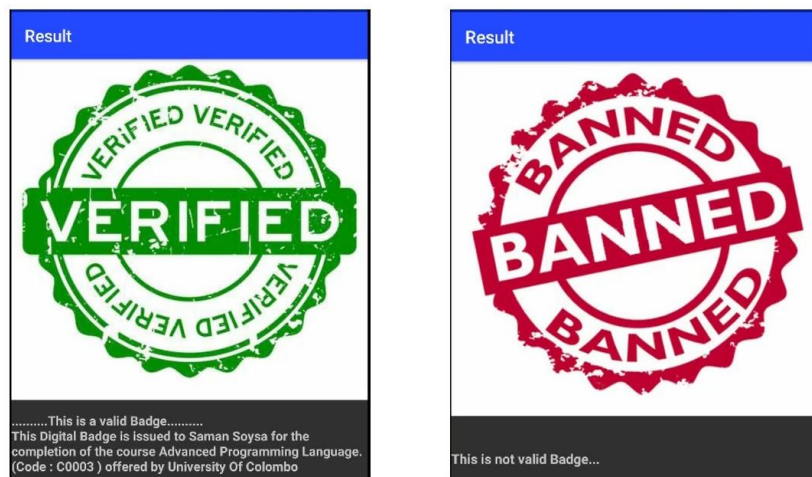


Figure 20 : output verified/banned

As it describes above, it shows the details embed with the badge and the Button to go to online page which has details of the badge when read the QR code from the mobile application. Usually, Badge details are shows from the client application. But here it uses direct call to server application to get badge details. It is a framework feature. So, it shows the badge is original only if the badge is original and show error message saying ‘badge is not original’ if it uses wrong details.

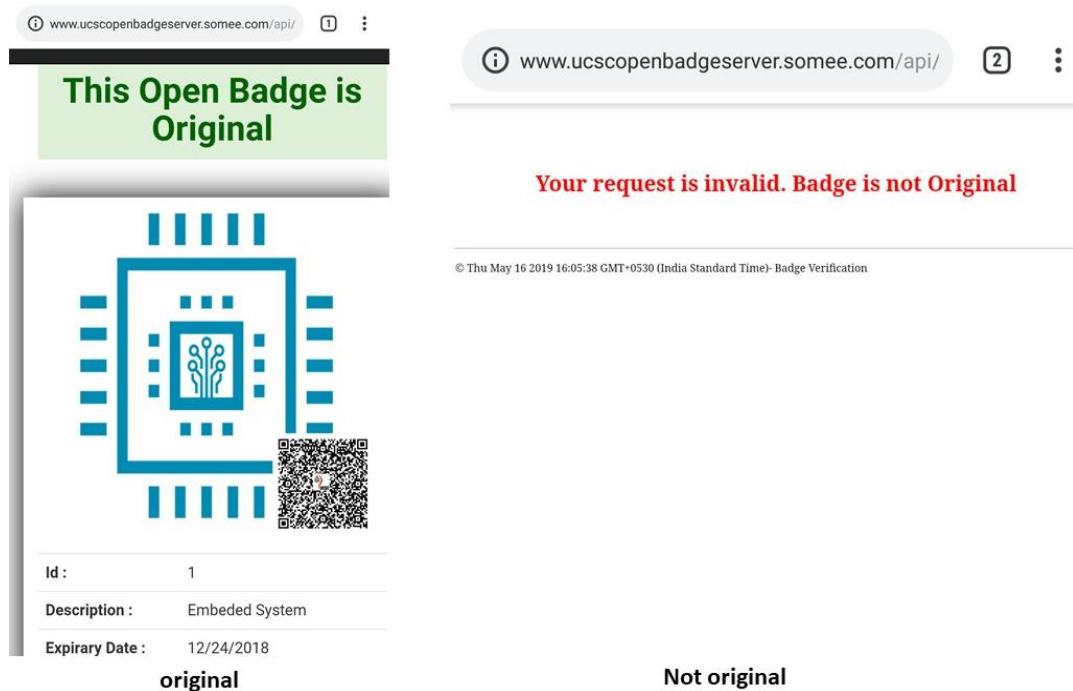


Figure 21: Shows Badge details online

So, AS a summery, this proposed idea gives more reliability and security to the open badge via below ways.

1. It embeds the badge details with the badge itself as QR code
2. QR code is encrypted and only mobile application can read it.
3. Once the App reads the QR code it gives the badge details hence cut and past the QR code to fake badge doesn't work due to embed details are mismatch
4. It gives the button to check the badge online. This page is a framework feature and it doesn't link with client application. It shows badge and confirmation message if the badge is original and if not, it shows above error (right image of figure 21). So copying the QR code to fake badge is useless.

Hence cut pad past the QR code doesn't work for the fake badge because, QR code has different data and the Linked page doesn't has the information of the fake badge. further the parameters which are in URL are encrypted and not easy to understand what it is.

It doesn't keep those data in QR code as plain text which anybody can read. It uses encryption mechanism to encrypt data. This mechanism is common and simple encryption mechanism with .NET and Android has. So, it uses Base 64 encryption mechanism. Further it has done few changes the encrypted string to remove the ability to decrypt it by Base64 decryption directly to get plain text back. Hence it needs to have an mobile application which is developed to read this QR code because logic to get decryptable data is embed with spp. or else you will end up as below.

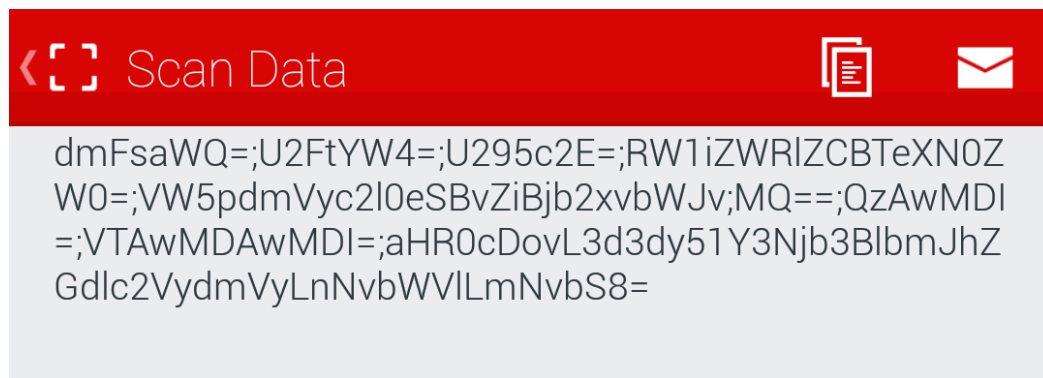


Figure 22 : content of QR code

According to this code has information to identify the recipient, fake recipient can't use Someone's QR code and show to others because QR code gives the details about original recipient and if fake party creates the QR code and attached which is not in the logic which application designed to read, it gives message saying 'Banned'. (figure 20)

Additional this new feature gives the offline verification as well as the information about the badge. Therefore, it doesn't need to be always be online to get badge details from the linked paged. Hence it enables new facilities such as below.

1. Enhance trustworthiness of the badge between recipient and person who see it.
2. No need to pay for data (internet) to get Badge Details.
3. Offline verification for the badge
4. Previously, Open badge could be use online only hence if you are not online, it is just an image. But with this concept, recipient it could be use offline (could be used as evidence in CV).
5. Not able to hack and create duplicate badge.

4.0. EVALUATION PLAN

4.1. OVERALL VERIFICATION OF PROJECT

This project is to propose a novel and research-based approach to solve the verification issues associate with the Open Badge. The end user of the solution is IT and Non-IT persons. Therefore, the proposed solution should not be much complex and difficult to understand. Because the Non-IT people will not willing to use much complex IT solutions to overcome the problems. Therefore, it is using the existing and popular technologies for the verification mechanism and it keeps the currently existing mechanisms for verification with Open Badge such as linked web page and SSL certificates.

First, I have done the survey to make sure the requirement of this project to be developed and second survey is conducted to verify and validate the solution with people which has technical knowledge and the experience in IT industry. Reason for selecting IT-people is because most of them has an idea of E-Learning, Badges concepts and some of them already achieved the badges by playing games etc. hence they got the objectives when I explain the issue to them and they will fill the surveys with their IT knowledge and experience.

Survey - Is this essential to be developed?

(Appendix B/E – Recipient Survey/Result | Appendix C/F- Issuer Survey/Result)

I have done two surveys to two major stakeholders and those are Teachers (badge Issuer) and Students (Badge recipient). Survey questions are categorized into 4 categories according to the project expectation. Those categories and the question numbers are listed below.

To Check the awareness of the Badge and Open Badge

Table 4-1: Result of Issuer & Recipient Survey for awareness

	Recipient Survey	Issuer Survey	Result
Question List	1, 2, 4	1, 2, 3	$\frac{\frac{71.1 + 53.3 + 78.9}{3} + \frac{90.9 + 75.8 + [(60.6 \times 0.75) + (9.1 \times 1) + (21.2 \times 0.5)]}{3}}{2}$ = 72.54%

To Check have they experience the Badge correctly?

Table 4-2: Result of Issuer & Recipient Survey for Experience

	Recipient Survey	Issuer Survey	Result
Question List	3,5	4,5	<p>Recipient Survey</p> <p>For Q3 and Q5 =</p> $\frac{[(21.1 \times 0.5) + (23.7 \times 0.25) + (31.6 \times 0.75) + (21.1 \times 1)] + [42.1 + (26.3 \times 0.75) + (26.3 \times 0.5) + (2.6)]}{2} =$ <p>69.425%</p> <p>Issuer Survey</p> <p>For Q4 and Q5 =</p> $\frac{[(36.4 \times 0.5) + (60.6) + (3 \times 0.25)] + [(0.5 \times 36.4) + (0.75 \times 39.4) + (21.2) + (3 \times 0.25)]}{2} =$ <p>74.63%</p> <p>Hence = $(69.425 + 74.63) / 2 = 72.02$</p>

To Identify how they suffer with verification issue

Table 4-3: Result of Issuer & Recipient Survey about issue

	Recipient Survey	Issuer Survey	Result
Question List	6,7	6,7,8	<p>Recipient Survey</p> <p>For Q6 and Q7 = Assume Silent also give 50% to positive</p> $\frac{[(100 - (28.9 \times 0.5)) + (100 - (52.6 \times 0.5))]}{2} = 79.625\%$ <p>Issuer Survey</p> <p>For Q6, Q7 and Q8 =</p> $\frac{[(100 - (27.3 \times 0.5)) + (100 - (30.3 \times 0.5))] + (45.5 \times 0.75 + 9.1 + 39.4 \times 0.25)}{3} =$ <p>74.76%</p> <p>Hence = $(79.625 + 74.76) / 2 = 77.19\%$</p>

To check how much would need the solution

Table 4-4: Result of Issuer & Recipient Survey for asking solution

	Recipient Survey	Issuer Survey	Result
Question List	8,9	9,10	<p>Recipient Survey</p> <p>For Q8 and Q9 =</p> $\frac{(10.5 \times 0.25) + (23.7 \times 0.5) + (31.6 \times 0.75) + (34.2) + 50 + (36.8 \times 0.75) + (10.5 \times 0.5)}{2}$ <p>= 77.612%</p> <p>Issuer Survey</p> <p>For Q9 and Q10 =</p> $\frac{[9.1 + (54.5 * 0.75) + (33.3 * 0.5) + (3 * 0.25)] + [15.2 + (45.5 * 0.75) + (36.4 * 0.5) + (3 * 0.25)]}{2}$ <p>= 67.825</p> <p>Hence = $(77.612 + 67.825)/2 = 72.71\%$</p>

According to this survey more than 70% of people aware of Open Badges/badges and 77.19% percent of people have been faces or think of this issue, the Verification of Open badges. then they will not use the badge with confident. Finally, 72.71% (majority) of people is thinking that it is good to have a solution to above verification issue than current Open Badge system even though they are using SSL certificate with bind URL (HTTPS protocol).

Survey - To find overall success of the outcome (Refer Appendix-D for the survey)

After the solution is developed I have demonstrated this solution to group of well experienced IT persons such as Software Engineers (Senior and Higher), IT Teachers, IT lecturers, Quality Assurance Engineers, Business System Analysis (Senior and Higher) because those guys are deeply knowing about technology behind this concept such as SSL certificate, HTTPS protocols, how web works, how QR code works, How the mobile app should be built and those people has good knowledge of how end user work with IT products because it is a part of their working life. So, it is easy them to comment on how easy this solution to Non-IT person.

This survey has 5 questions and one field to enter comment. Survey checks reliability concerns, usability and how easy to understand by end-users.

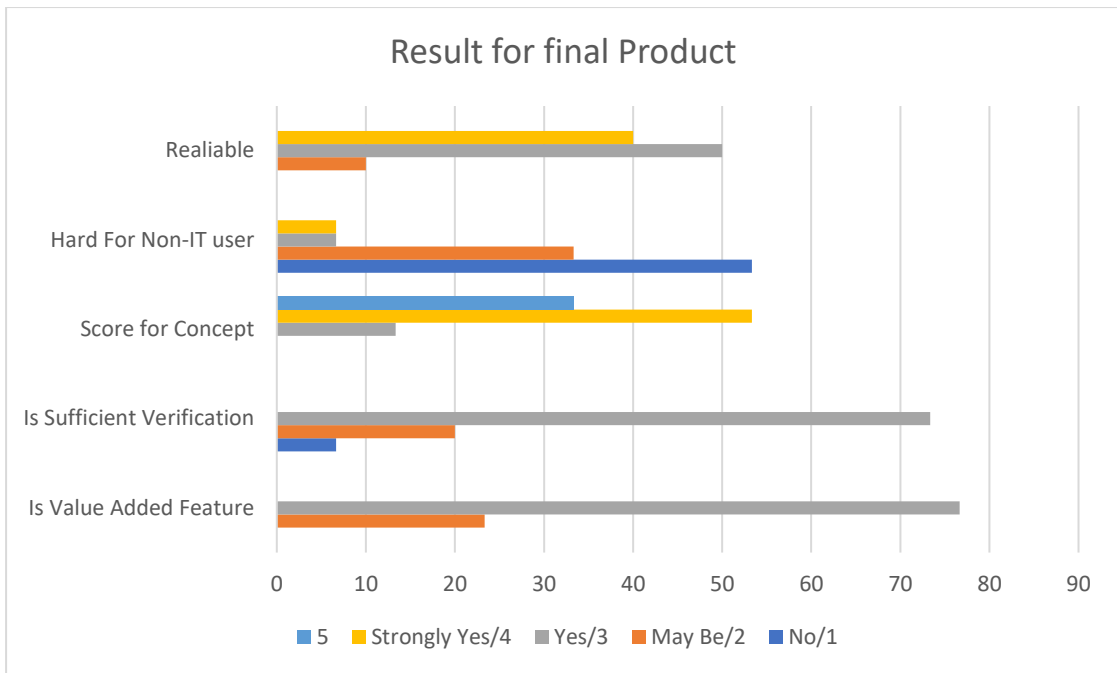


Figure 23 : Result for final Product

Table 4-5: Result of final Product

Reliability	$40 + (0.75 * 50) + (0.5 * 10) = 82.5\%$	Success
Easy to understand by Non -IT person	$53.3 + (0.75 * 33.3) + (0.5 * 6.6) + (0.25 * 6.6) = 83.25\%$	easy to user
How new idea is success and valuable	<p>Value Added feature</p> $76.6 + (23.3 * 0.66) = 91.97\%$ <p>Score for new idea=</p> $33.3 + (53.4 * 0.8) + (13.3 * 0.6) = 83.4\%$ <p>Average: $(83.4 + 91.97) / 2 = 87.68\%$</p>	Above 85% and it seems that this new idea is successful among group of IT persons and it support to expect success among others based on this.

More than 80% of the participant has been commented this as a good and great concept due to additional advantages which they able to gain based on this and another 20% has not been written down any comment.

All the participant for this survey is technical person or who are working in IT related area. Therefore, based on this survey, Overall success of this idea is 87.68% and it is above the acceptable level. Further, the result for Easiness of using the solution is 83.25%. it is good score because there are few QA Engineers/Business System Analysis who have vote for this success and they are the people who think from customers side and have good idea about customer and how they work. Based on all above, it is possible to mention without any doubt that the proposed solution is successful.

5.0. CONCLUSION AND FUTURE WORK

Open Badge is a most valuable concept in E-learning. It has a lot of advantages, benefits to use Open Badges than real world certifications. Open Badges are designed and intended, to serve as mini-certifications. A badge is a digital representation of an existing activity, like the completion of a class, an assessment or a demonstration of skills or abilities [21]. If you earn open badges, those are not destroyed as real-world certificate in flooding or any disaster. Because they are digital, it saves space, it gives recognition as certificates and so on. So, this plays a major role in E-Learning to give an accreditation.

5.1. CONCLUSION

As it is described in above chapter, this new concept will open a new era of open badge. It enhances the security aspect of the badge. Because if some thief creates the same looking QR code with fraud information that QR code will be reject from mobile app and it identified that it is not designed from this proposed system. Because the algorithm doesn't match to read the QR code. If someone tries to use the QR code from existing original Badge which is awarded to someone else, the read information from QR code does not match with the fraud badge details such as recipient name, issuer etc. and the web page which load is not match with the fraud information. It gives the details about original person and link to Original page which has details. Therefore, Thief cannot hack the badge in any way.

So, it enhances the value of the Open badge. Previously Open badge should be used over the internet because it should support to load the linked page to see the details of the badge. If not, it is just an image. But with this concept, it is not just an image. It is an Open Badge and details of the badge is embedded as QR code to the badge itself. However, new solution is value added feature and all previous functions are available such as using a Link to show details of the badge (online) and enable usage in offline mode. Therefore, people can past the badge in to any place such as to CV or share among social media with the link or without a link. Because if you have the Open badge reader application can read the badge and get its details. Then they can validate the badge with the person's details who share it or past it. Further, it gives more benefits such as,

1. Enhance trustworthiness of the badge between recipient and person who see it.
2. No need to pay for data (internet) to get Badge Details.
3. Offline verification for the badge
4. Previously, Open badge could be use online only hence if you are not online, it is just an image. But with this concept, recipient it could be use offline (could be used as evidence in CV).
5. Not able to hack and create duplicate badge.

Based on all above it can be conclude as that this creates the new era of Open badge and people will use it because no one can create fraud badge as original and it is symbol of excellence which the recipient of badge has achieved.

5.2. FUTURE WORK.

With this idea, it wraps up the information about the badge and attached with itself. But this doesn't have a mechanism to identify the validity of the organization or the trustworthiness of the organization. There is a way to identify that the badge is an output of this proposed system, but it doesn't have a method to identify that the badge is awarded from the specific organization or an institute. If it is possible use RSA encryption mechanism, it is possible to identify the badge issuer correctly.

As more details of this work, it encrypts the data with the badge by using the private key which issued to the organization and publish the public key to common store. It should add an encrypted text of the organization but the encryption mechanism which used to encrypt the Organization Name should not be a RSA because it should be easily decrypt the organization name to decrypt data by using public key.

When mobile app reads the encrypted organization name first, it gets the public key of the given organization and decrypt the encrypted data. If possible to decrypt, Issuer is confirmed. If not, the badge is not an original badge.

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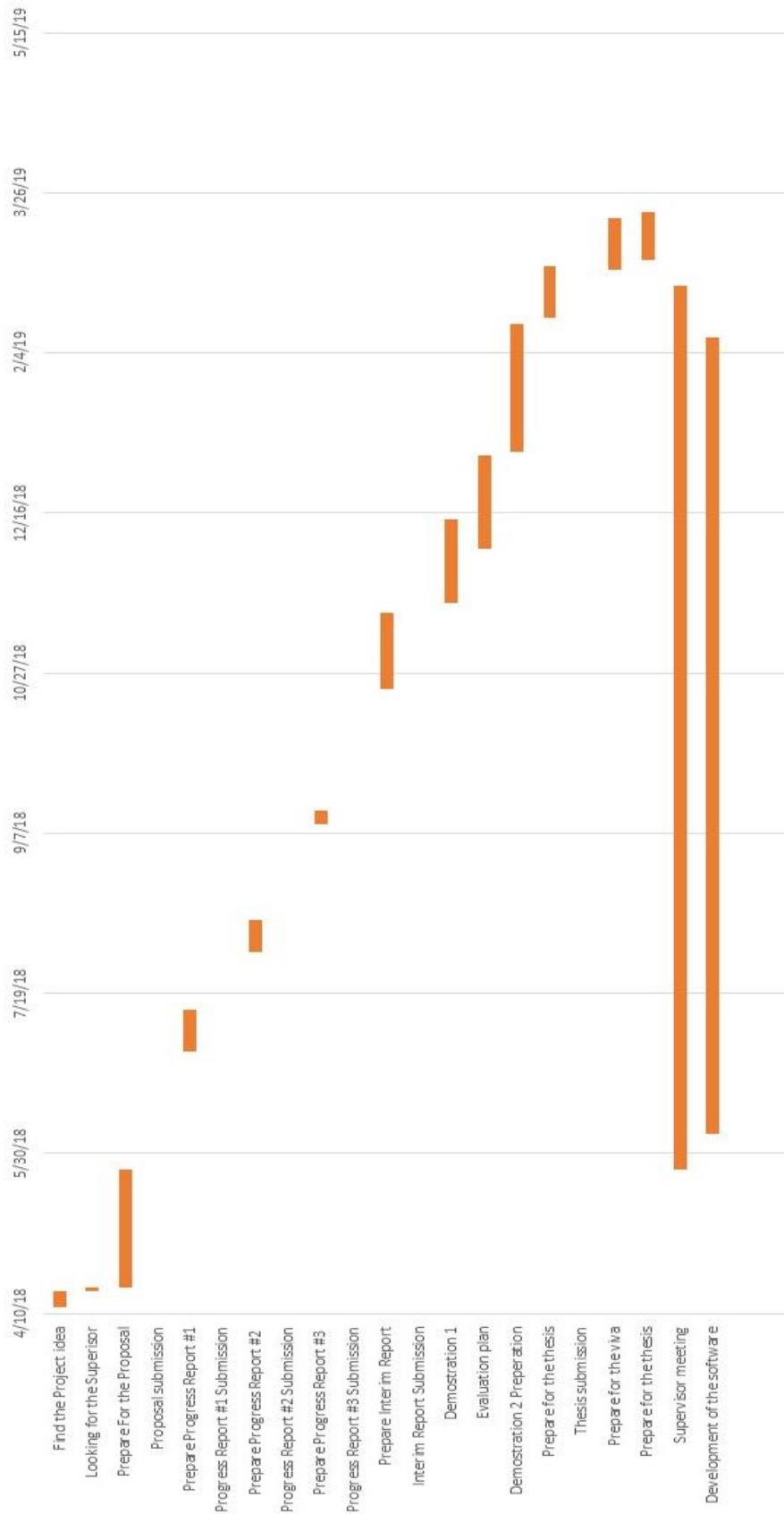
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APPENDIX

APPENDIX A – PROJECT PLAN



APPENDIX B – RECIPIENT SURVEY

This survey supports to the partial fulfilment of research project which is named as “Digital Validation Framework for Open Badge” of final year – MCS (Master of computer science) at UCSC

Target Audience

Student (above grade 10) with IT literacy

Concept:

Badge is normally awarded when someone achieve a target such as completing the level. This is more popular concept in real world and this survey is to discuss a security issue we face when we try to use those badge concept in digital world.

Guide Line

Please be honest and Answer all the questions

All Right Reserved.

1. Do you know what is the badge?

Yes No

2. Did you receive the badge for your achievement?

Yes No

3. Do you feel happy and motivate to reach next badge? (e.g Scouts are collecting badges)

1 2 3 4 5

4. Did you receive badges when you are playing computer games?

Yes No

5. Do you think to share the received badges with your friend to say that you have achieved some level of the game?
- 1 2 3 4 5
6. What do you feel when someone who didn't play the game have showed the fraud badge which looks exact same as your badge which takes hours of hard work?
1. Tell others that the shown badge is fraud
 2. Tell friend to not to do illegal things and you shame on him.
 3. You try to prove that you have did it and not him.
 4. Ignore your badge and keep silent
7. Think you don't have any evidence to your achievement at the time when someone show fraud badge. So, what do you think to do?
1. Tell others that the shown badge is fraud
 2. Tell friend to not to do illegal things and you shame on him.
 3. You try to prove that you have did it and not him.
 4. Keep silent
8. What do you think if your badge has clue of original which cannot be copied by others. (1- feel sad. 5 – Feel Great)
- 1 2 3 4 5
9. Do you think above feature is essential when badge is awarded in digital world?
- 1 2 3 4 5
10. If you received the badge which has original symbol which cannot be copied, Do you proudly show it to others?
- 1 2 3 4 5

APPENDIX C – ISSUER SURVEY

This survey supports to the partial fulfilment of research project which is named as “Digital Validation Framework for Open Badge” of final year – MCS (Master of computer science) at UCSC

Target Audience

Teachers with IT literacy

Concept:

Badge is normally awarded when someone achieve a target such as completing the level. This is more popular concept in real world and this survey is to discuss a security issue we face when we try to use those badge concept in digital world.

Guide Line

Please be honest and Answer all the questions

All Right Reserved.

1. Do you know what is the badge?

Yes No

2. Do you aware about Open Badge in E-Learning?

Yes No

3. Do you agree with awarding badge to someone when they have done some significant work?

1 2 3 4 5

4. Do you award Badge or Certificate to student to show others to say that they have done that significant work?

1 2 3 4 5

5. Do you think that awarding badge will motivate them to do next target?

1 2 3 4 5

6. Think you as a reputed teacher and you award badges to student for their achievement such as completing the level. What do you do when someone create badge with same look and award it to someone who didn't do such a great work?

5. Tell others that the shown badge is fraud

6. Go to the police and take legal action.

7. You try to prove that other badge is fraud and not original.

8. Ignore it and continue your work

7. Think you don't have any evidence to say that your badge is original. So, what do you do in above situation?

5. Tell others that the shown badge is fraud.

6. You try to prove that your badge is original.

7. Keep silent.

8. There is digital badge (badge you received in digital world) which is awarded by reputed company and they use URL to say badge details such as your name, reason to award the badge etc. They have use URL with HTTPS protocol (HTTPS protocol use SSL certificate. It is a signature of the company). Do you think this method is enough to prove originality of the badge?

1 2 3 4 5

9. What do you think if you able to attach a clue which cannot be copied such as hologram sticker in Bajaj Auto parts to your badge.

Does this increase your confidence of awarding badge to student?

(1- feel sad. 5 – Feel Great)

1 2 3 4 5

10. Do you think above feature is essential when badge is awarded in digital world?

1 2 3 4 5

APPENDIX D – TO EVALUATE FINAL OUTCOMES OF THE PROJECT

This survey supports to the partial fulfillment of research project which is named as “Digital Validation Framework for Open Badge” of final year

– MCS (Master of computer science) at UCSC



Target Audience

Badge viewers

Concept:

Badge is normally awarded when someone achieve a target such as completing the level. This is more popular concept in real world and this survey is to discuss a security issue we face when we try to use those badge concept in digital world.

Guide Line

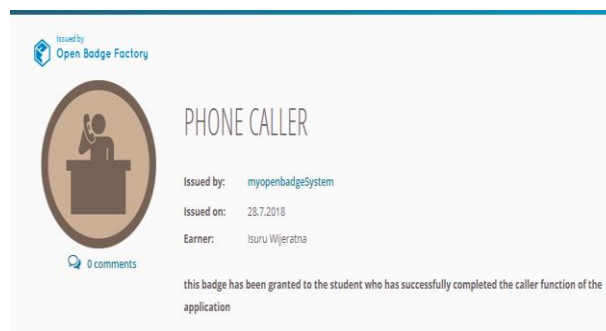
Please be honest and Answer all the questions

All Right Reserved.

What is Open Badge:

This is a digital badge which is awarded to some great achievement in E-Learning Domain such as finishing a Course, Finishing a Level of a Game etc.

Current Open Badge is looks as below



And it is bind with URL which has badge details

https://openbadgepassport.com/app/badge/info/86375?fbclid=IwAR1oqbKK3TfrKvDAhjGa5CxwUGToM5tMXBqm4H_ZX4fEUjduprAR0_9OOeI

This URL is equipped with HTTPS protocol which has the SSL certificate which act as a signature of the issuer and when you load the URL, you can see the details of the badge as above

But there is high possibility to someone to steal this Badge (Image) and create the badge which looks as same and create URL with HTTPS and act as above. Hence reliability issue is there. Hence people don't trust the badge as expected. If you don't have internet, this badge is just an image

Proposed system



Create a badge with Embed information and which support to do offline verification of the badge and this support for all above security features such as loading badge information with HTTPS URL. Then viewer can match those details (information from Web page and the Verifier application) and keep trust on it. these information on a badge are encrypted in special algorithm which can be decrypted by using verifier app only.

Additionally, this new concept gives few more benefits such as offline verification, use the badge offline etc.

1. What is your designation?

2. Do you think this new concept is a value-added feature?

No Maybe Yes

3. Do you think this new concept gives sufficient verification to the Badge when compared to old version?

No Maybe Yes

4. What is your score for this concept?

1 2 3 4 5

5. Do you think this idea is hard to use/understand by Non-IT end users?

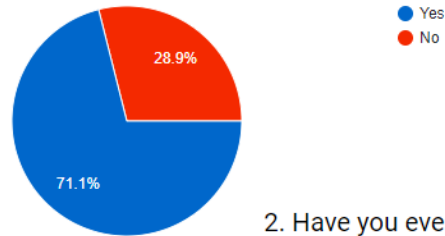
No Maybe yes Strongly Yes

6. Do you think this idea will enhance the reliability of the badge?
No Maybe yes Strongly Yes

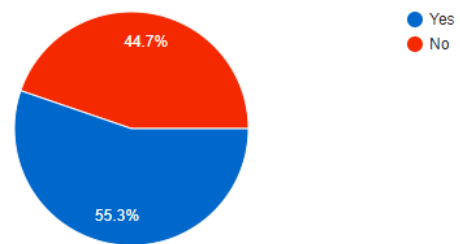
7. Any Comment

APPENDIX E – RECIPIENT SURVEY RESULT

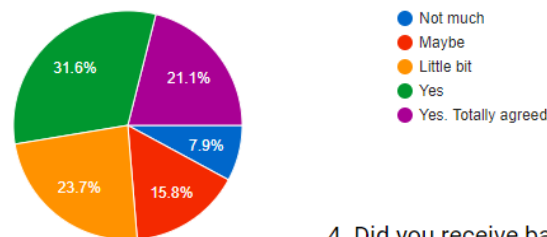
1. Are you aware of the concept of awarding a badge?



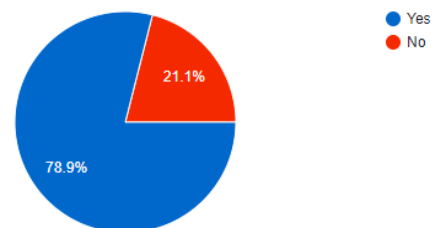
2. Have you ever received a badge for your achievement?



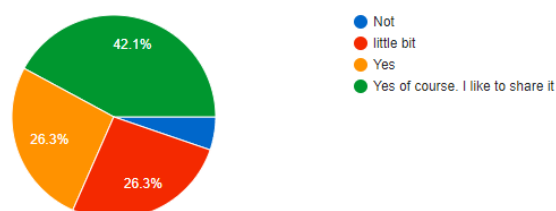
3. Do you feel happy and motivate to achieve next badge when you received the badge? (e.g Scouts are collecting badges)



4. Did you receive badges when you are playing computer games?



5. Do you think to share the received badges with your friend to say that you have achieved some level of the game?



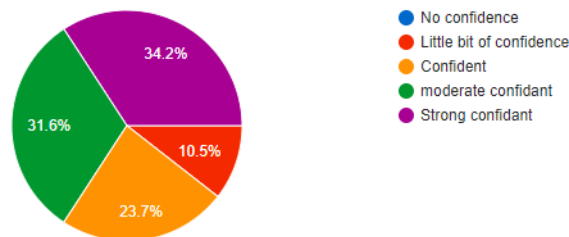
6. What do you feel when someone who didn't play the game have showed the fraud badge which looks exact same as your badge which takes hours of hard work?



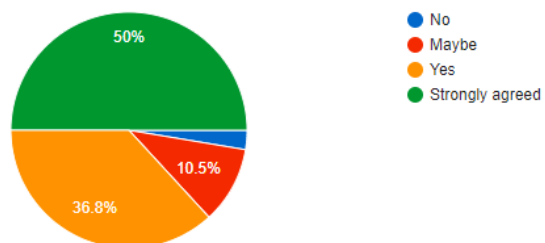
7. Think you don't have any evidence to your achievement at the time when someone shows fraud badge. So, what do you think to do?



8. What do you think if your badge has a sign to indicate that it is original which cannot be copied by others. what is your feeling about the badge

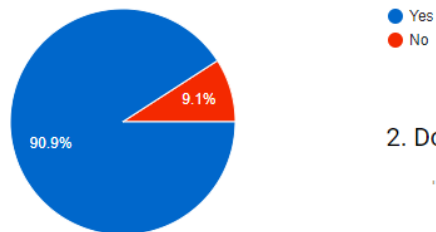


9. Do you think above feature is essential when badge is awarded in digital world?

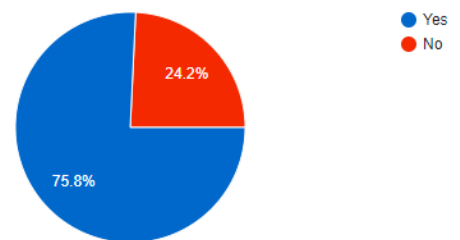


APPENDIX F – ISSUER SURVEY RESULT

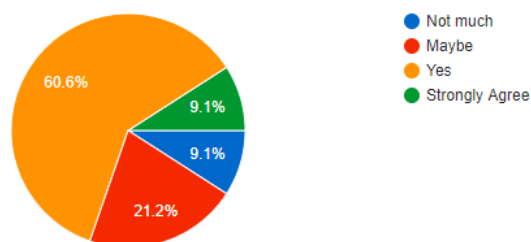
1. Do you aware of the concept of awarding a badge



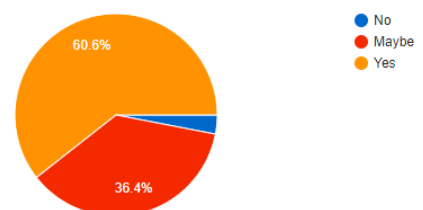
2. Do you aware about Open Badge in E-Learning?



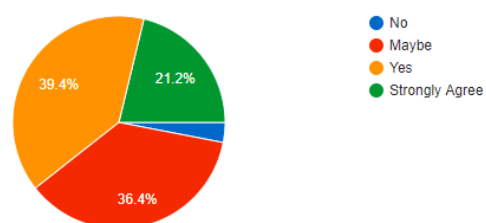
3. Do you agree with awarding badge to someone when they have done some significant work?



4. Do you award Badge or Certificate to student to show others to say that they have done that significant work?



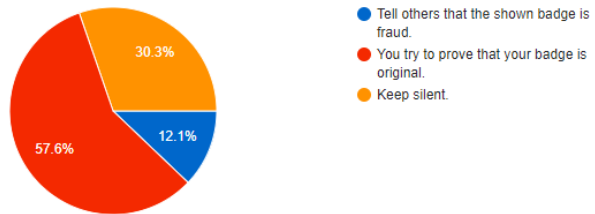
5. Do you think that awarding badge will motivate them to do next target?



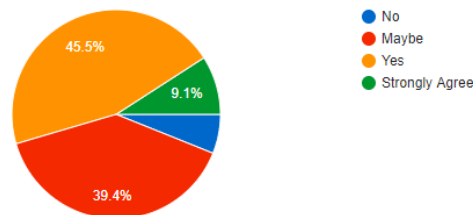
6. Think you are a reputed teacher and you award badges to student for their achievement such as completing the level. What do you do when someone create badge with same look and award it to someone who didn't do such a hard work?



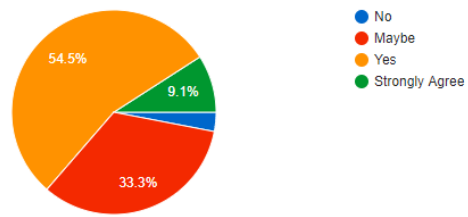
7. Think you don't have any evidence to say that your badge is original. So, what do you do in above situation



8. There is digital badge (badge you received in digital world) which is awarded by reputed company and they use URL to say badge details such as your name, reason to award the badge etc. They have use URL with HTTPS protocol (HTTPS protocol use SSL certificate. It is a signature of the company). Do you think this method is enough to prove originality of the badge?



9. Assume you able to attach a clue which cannot be copied (such as a hologram sticker in Bajaj Auto parts) to your badge. Does this increase your confidence of awarding badge to student?



10. Do you think above feature is essential when badge is awarded in digital world?

