

Consumer Adoption of Smart Biometric Lock Among SAARC Nations

Vikas Garg, Sonam Rani, Himanshu Matta

Abstract: In today's fast-moving lifestyle people need to adopt more convenient and secure gadgets to make their life simpler. For meeting this goal there is an innovative product proposed named Smart Biometric Lock, which looks like a simple lock but includes a high tech biometric (fingerprint recognition) innovation which makes it a secure as well as convenient product. This product is free from number lock or traditional key lock hassle as well as more convenient to use especially for children and old people. This research has proposed an innovative model of biometric lock and empirically tested its adoption in SAARC nation's consumers by collecting data using questionnaire among 200 SAARC nations' respondents. This research will investigate the usefulness of this product in SAARC nation's scenario as well the willingness of SAARC nationals to adopt this innovation using questionnaire survey method. Results are summarized using SPSS software and conclusions are drawn which shows most of the SAARC nationals' respondents are willing to adopt this product if its repair cost is reduced as well as results shows the Indians, Nepalese, Pakistanis prefers security feature over other features whereas other countries prefer convenience features of SBL. Later recommendations to improve adoption of this product are given.

Index Terms: Biometric, Global System for Mobile Communication (GSM), Radio-Frequency Identification (RFID), Smart Biometric Lock (SBL).

I. INTRODUCTION

Smart biometric lock is an innovative device that looks exactly like a normal lock but instead of traditional lock and key feature it has biometric fingerprint scanner installed in it. It is free from number lock or traditional key lock hassle as well as more convenient to use especially for children and old people. Biometrics is the analysis of people's unique physical characteristics. (Rouse, 2018) [15].

A. Benefits of Biometrics

Biometrics enables user's authentication and convenience in multiple areas especially in security. There is various MNC's nowadays using biometrics in their products especially in smart phones like Apple and Samsung are inserting fingerprint scanners in their phones as well as retina scanning.

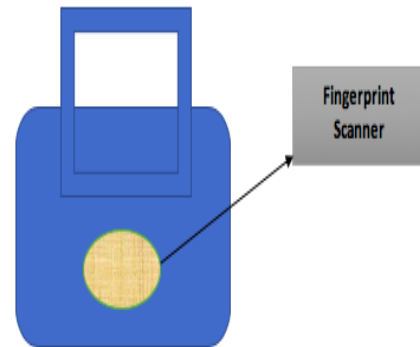


Fig. 1: Proposed smart lock design

Biometrics is nowadays used in various fields like in HR for maintaining attendance, in Security areas as well as in commercial products like smart phones. Biometrics includes fingerprint, iris, facial scanning as well. Researchers have proposed the use of iris scanning technology for cryptographic applications. (Falohun A. S, 2012)[7].

Biometrics provides users with security and convenience. MNC's like Apple have implemented biometrics in the form of 3D facial scanning in their iPhone X launched in 2017 which has enhanced the user experience of iPhone customers.

Moreover, biometrics are nowadays used in Identity Cards of offices as well as government of India had launched Aadhar card which is personal ID of citizens of India based on biometrics. (Vikas Garg, 2018) [17]

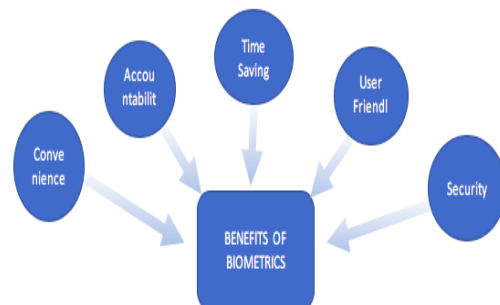


Fig. 2: Benefits of biometric

Revised Manuscript Received on December 22, 2018.

Vikas Garg, Amity Business School, Amity University, Uttar Pradesh, India.

Sonam Rani, Amity Business School, Amity University, Uttar Pradesh, India.

Himanshu Matta, Amity Business School, Amity University, Uttar Pradesh, India.

Consumer Adoption of Smart Biometric Lock Among SAARC Nations

1858	First systematic capture of hand images for identification purpose was recorded
1896	Henry develops a fingerprint classification system
1936	Concept of using the iris pattern for identification was proposed
1960	Face recognition becomes semi-automated
1965	Automated signature recognition research begins
1974	First commercial hand geometry systems become available
1992	Biometric consortium is established within US government
2002	ISO/IEC standards committee on biometric is established
2010	U.S. national security apparatus utilizes biometrics for terrorist identification
2013	Apple includes fingerprint scanners into consumer target smart phones

(Source: National Science and Technology Council Report)

Fig. 3: Evolution of biometrics applications

B. Biometrics and Locks

Smart biometric lock is an innovative device that looks exactly like a normal lock but instead of traditional lock and key feature it has biometric fingerprint scanner installed in it. It is free from number lock or traditional key lock hassle as well as more convenient to use especially for children and old people.

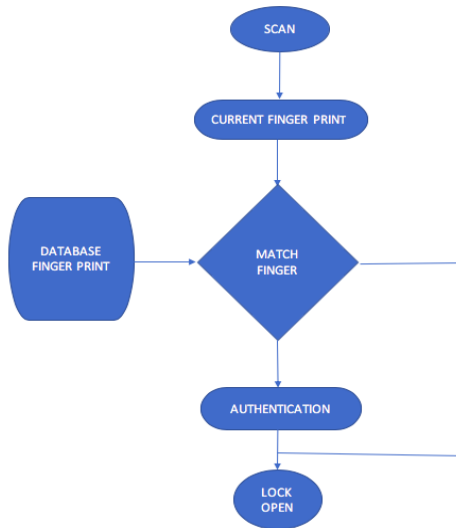


Fig. 4: Proposed working model of SBL

C. Advantages of Smart Biometric Lock

- Convenience
- Security
- Smart notification and alert system via SMS
- Smart android as well as Apple store application for remote control of lock
- In-built sensors to identify forceful touch on lock and smart alert to nearby police station as well as to the owner.
- Ease of use by children and old people
- No worries to manage keys
- Ten fingerprints can be registered for entire family.

II. LITERATURE REVIEW

There are various researches done on biometric locks systems like **Pradnya R. Nehete, J. P. Chaudhari, S. R. Pachpande, K. P. Rane, (2016) [11]** in their paper reviewed and concluded various papers on upcoming smart lock technologies like biometric locks, locks with GPS, GSM based, Bluetooth based, OTP based, RFID based locks etc. and listed out the problems with each type of lock technology

like locks with facial recognition requires more reliability etc. **SALAM ABEED DAHE, (2015) [6]** in their paper studied the advantages of biometric lock technology over other lock technologies like locks based on RFID's. He concluded that biometric lock technology is superior among the other lock technologies. He recommended the modifications and other uses of this biometric lock technology too. **Komal and Dhiraj (2015) [10]** proposed RFID based Campus Access Management System. They suggested modification in this system by adding biometric technology in it.

Whereas **S. O. Anaza, (2017) [4]** in their paper reviewed and concluded various papers on upcoming smart lock technologies and identified the advantages and disadvantages of upcoming innovative lock systems. **Ramani et al (2013) [14]**, in their paper proposed an automobile locking system that will work on GPS and GSM technologies that will provide exact location of automobiles with ability remote locking of automobile by the owner. This system will also include SMS alerts for unauthorised access to vehicle or in theft situations.

Hussaini et al., (2014) [8], proposed GSM centred biometric lock system that scans fingerprints and provide access to authorised persons. He suggested this model will be improved by complementing it with security facilities which focus on the user instead of admin personnel. **Raghu and Subramanian (2013) [13]** proposed a lock constructed on RFID, Fingerprint, and technology. They proposed that this system is the most secured locking system. **Kawale (2013) [9]**, in their paper explored the benefits of fingerprint lock system of traditional locking system. They compared fingerprint lock system with pin and password-based lock systems.

While **Priti and Zadem (2014)[12]**, in their paper proposed a security system for automobiles based on facial recognition which will also takes the snaps of person entering the car and send alerts to owners through MMS's if unauthorised person tries to enter the vehicle. He suggested this technology will be future for automobile security systems. **Tintu Pious(2017)[16]** in their paper proposed a prototype model based on the biometric lock system for automobiles for more security in locking automobiles and thereby minimising theft of cars. They suggested the biometric locks in automobiles will the future of automobile industry innovation.

While **Aanchal Jindal Devanshu Pal Nitish Bhardwaj Arvind Panwar (2013) [1]**, in their paper verified the security and reliability of biometric locks and also highlighted vulnerabilities in this technology.

While some researchers proposed prototype biometric lock systems like **Dinesh Bhatia (2014) [5]** in their paper proposed a smart door access system using fingerprint to provide high security with access to authorised persons only. He proposed use of motorised system for locking the door.

SALAM ABEED DAHE, (2015) [6], conducted a Study focused on conceptual design of biometrics technology in door lock security system. He suggested that nowadays, there are two main types of lock, which are, the mechanical and the electronic lock. The conventional mechanical lock is limited and has a lot of downside compare to the electronic one. The mechanical one is limited with its keyway, where any lock with a keyway is susceptible to picking. There are many types of electronic lock with different way of operating method like, RFID, combination code, smart card, and biometrics. Each has its advantages and disadvantages. All of them user has to have a mean like a key in the case of mechanical lock or the card in the case of the smart card, or user need to remember a code for the case of the combination lock. However, in this project biometrics locks overcome all the above limitation.

Pradnya R. Nehete, J. P. Chaudhari, S. R. Pachpande, K. P. Rane, (2016) [11] in their reviewed various literature present on biometric and smart locks and compared each researches findings and advantages. **Alfakhri M. Murshed, (2018) [2]** in their paper proposed a model based on biometric lock system for door locks in high security areas. **Vikas Garg (2018) [17]** in their exploratory reasearch paper proposed a Biometric based attendance system for increasing employee discipline and productivity. They also suggested scope of biometric technology in other areas like home security etc. While **Amuda F.A (2017) [3]** in their paper explored the scope of fingerprint authentication technology and its future and current applications in various areas like car locking, ATM-machines etc.

III. RESEARCH METHODOLOGY

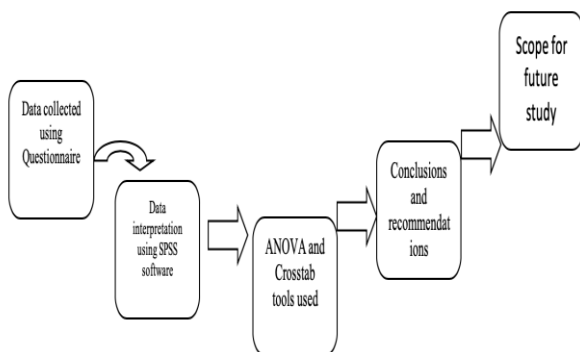


Fig. 5: Process of Research

A. 3.1 Type of research

This research is a descriptive research as we describe the Consumer adoption of Smart Biometric Lock among SAARC nations.

B. Objectives of Study

- To identify Consumer adoption of Smart Biometric Lock among SAARC nations.
- To identify Consumer attitude towards Smart Biometric Lock among SAARC nations.

- To compare Consumer adoption of Smart Biometric Lock among SAARC nations.
- To suggest ways to improve adoption of Smart Biometric Locks in SAARC nations

C. Rationale of study

In today's fast-moving lifestyle people need to adopt more convenient and secure gadgets to make their life simpler. For meeting this goal there is an innovative product in foreign markets named Smart Biometric Lock, which looks like a simple lock but includes a high tech biometric (fingerprint recognition) innovation which makes it a secure as well as convenient product. SAARC nation's consumers are importing this product as it is free from number lock or traditional key lock hassle as well as more convenient to use especially for children and old people. This research will investigate the usefulness of this product in SAARC nation's scenario as well the willingness of SAARC nationals to adopt this innovation (innovation adoption model) using questionnaire survey method.

D. Data collection tools

This study is done with both primary and secondary data. The tools used to analyse the data are ANOVA, regression, correlation.

E. Area of the Study

For this study the respondents will be randomly selected from SAARC nations.

F. Research Approach

For this study, questionnaire method is used for collecting data.

G. Sampling Technique and Sample Size

Convenience sampling method is used and sample size is 200.

H. Research Instrument

Data is collected through structured questionnaire. Secondary data is collected from, web sites, E-book, Journals etc.

IV. DATA COLLECTION AND ANALYSIS

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	1.835	7	.262	.510	.827 ^b
	Residual	98.785	192	.515		
	Total	100.620	199			

a. Dependent Variable: Do you love to adopt this innovation
b. Predictors: (Constant), ANNUAL INCOME, Country of Origin, QUALIFICATION_NEW, OCCUPATION_NEW, MARTIAL STATUS, GENDER_NEW, AGE_NEW

Consumer Adoption of Smart Biometric Lock Among SAARC Nations

Table 2: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
(Constant)	1.017	.678		1.500	.135
AGE_NEW	.132	.114	.214	1.164	.246
Country of Origin	-.018	.025	-.053	-.731	.465
GENDER_NEW	.028	.121	.020	.236	.814
MARTIAL STATUS	.209	.251	.147	.835	.405
OCCUPATION_NEW	.049	.075	.050	.652	.515
QUALIFICATION_NEW	-.030	.055	-.042	-.538	.591
ANNUAL INCOME	.016	.071	.017	.223	.824

a. Dependent Variable: Do you love to adopt this innovation

ANOVA stands for analysis of variance which is a statistical tool for analysing variances among and between the group data.

The above table shows that there exists significant relationship between independent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (innovation adoption).

Table 3: ANNUAL INCOME * Do you love to adopt this innovation

Cross tabulation							
Count		Do you love to adopt this innovation					Total
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
ANNUAL INCOME	\$500-1500	19	27	0	0	1	47
	\$1500-\$3500	38	34	1	2	1	76
	\$3500 Above	34	39	2	2	0	77
Total		91	100	3	4	2	200

The above table shows that high income group people are more likely to adopt SBL innovation as compared to low annual income group people

Table 4 : Country of Origin * Do you love to adopt this innovation

Cross tabulation							
Count		Do you love to adopt this innovation					Total
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
Country of Origin	AFGANISTAN	9	9	1	1	0	20
	BANGLADESH	9	9	0	1	1	20
	BHUTAN	6	14	0	0	0	20
	INDIA	30	31	0	0	0	61
	MALDIVES	8	9	0	1	1	19
	NEPAL	12	7	1	0	0	20
	PAKISTAN	9	10	1	0	0	20
	SRI LANKA	8	11	0	1	0	20
	Total	91	100	3	4	2	200

The above table shows that Indians, Nepalese prefers to adopt SBL more rapidly.

Table 5: ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	1.835	7	.262	.510	.827 ^b
	Residual	98.785	192	.515		
	Total	100.620	199			

a. Dependent Variable: Do you prefer SBL over number lock?
b. Predictors: (Constant), ANNUAL INCOME, Country of Origin, QUALIFICATION_NEW, OCCUPATION_NEW, MARTIAL STATUS, GENDER_NEW, AGE_NEW

Table 6: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations				Collinearity Statistics	
	B	Std. Error				Beta	Zero-order	Partial	Part		Tolerance
(Constant)	1.017	.678		1.500	.135						
AGE_NEW	.132	.114	.214	1.164	.246	.092	.084	.083	.152	.659	1.529
Country of Origin	-.018	.025	-.053	-.731	.465	-.040	-.053	-.052	.091	.020	80.020
GENDER_NEW	.028	.121	.020	.236	.814	.073	.017	.017	.071	1.413	80.413
MARTIAL STATUS	.209	.251	.147	.835	.405	-.063	.060	.060	.164	6.094	16.094
OCCUPATION_NEW	.049	.075	.050	.652	.515	.044	.047	.047	.076	1.142	76.142
QUALIFICATION_NEW	-.030	.055	-.042	-.538	.591	-.055	-.039	-.038	.057	1.167	57.167
ANNUAL INCOME	.016	.071	.017	.223	.824	-.008	.016	.016	.048	1.179	84.179

a. Dependent Variable: Do you prefer SBL over number lock?

ANOVA stands for analysis of variance which is a statistical tool for analysing variances among and between the group data.

The above table shows that there exists significant relationship between independent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (preference of SBL over number lock)

Table 7: AGE_NEW * Do you prefer SBL over number lock?

Cross tabulation							
Count		Do you prefer SBL over number lock?					Total
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	



AGE_NEW	25 or less	46	46	2	2	0	96
	26-35	9	11	0	0	0	20
	36-45	24	29	1	2	0	56
	46-55	12	14	0	0	2	28
Total		91	100	3	4	2	200

ANOVA stands for analysis of variance which is a statistical tool for analysing variances among and between the group data.

The above table shows that respondents of age group 25 or less and from 36 to 45 prefer to adopt SBL over number lock.

Table 8: QUALIFICATION_NEW * Do you prefer SBL over number lock?

Cross tabulation

Count	Do you prefer SBL over number lock?					Total	
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree		
Other s	10	8	0	0	1	19	
QUALIFICATION_NEW	PG	41	49	2	2	1	95
	PhD	22	24	1	1	0	48
	UG	12	16	0	1	0	29
	XIITH	6	3	0	0	0	9
Total		91	100	3	4	2	200

The above table shows that respondents having more qualifications prefer to adopt SBL over number lock

Table 9: ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	6.109	7	.873	2.044	.052 ^b
Residual	81.971	192	.427		
Total	88.080	199			

a. Dependent Variable: Do you consider SBL as best option for your elders or children's?
b. Predictors: (Constant), ANNUAL INCOME, Country of Origin, QUALIFICATION_NEW, OCCUPATION_NEW, MARTIAL STATUS, GENDER_NEW, AGE_NEW

Table 10: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations				Collinearity Statistics		
	B	Std. Error				Beta	Zero-order	Partial	Partial	Tolerance	VIF	
(Constant)	2.227	.618		3.605	.000							
AGE_NEW	-.189	.1037	-.32830	-.1069	.212	-.131	-.127	-.152	.1592	.152	.592	6.592
Country of Origin	-.013	.0231	-.0486	-.558	.582	-.042	-.042	-.041	.980	.980	1.020	1.020
GENDER_NEW	.267	.110	.201427	.01639	.1173	.169	.169	.108	.748	.748	1.413	1.413
MARTIAL STATUS	-.442	.2283	-.33936	-.05467	.0835	-.138	-.135	-.164	.835	.835	6.094	6.094

OCCUPATION_NEW	-.060	.0685	-.06577	-.8381	.223	-.063	-.061	-.076	.8142
QUALIFICATION_NEW	-.013	.0509	-.0159	-.2796	.759	-.019	-.018	-.057	1.167
ANNUAL INCOME	.135	.065	.1582	.0387	.135	.14935	.14545	.848	1.179

a. Dependent Variable: Do you consider SBL as best option for your elders or children's?

ANOVA stands for analysis of variance which is a statistical tool for analysing variances among and between the group data.

The above table shows that there exists significant relationship between independent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (consider SBL as best option for elders and children's)

Table 11: ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	7.083	7	1.012	2.206	.035 ^b
Residual	88.072	192	.459		
Total	95.155	199			

a. Dependent Variable: What factors motivate you to adopt product like SBL?

b. Predictors: (Constant), ANNUAL INCOME, Country of Origin, QUALIFICATION_NEW, OCCUPATION_NEW, MARTIAL STATUS, GENDER_NEW, AGE_NEW

Table 12: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations				Collinearity Statistics		
	B	Std. Error				Beta	Zero-order	Partial	Partial	Tolerance	VIF	
(Constant)	2.209	.640		3.451	.001							
AGE_NEW	-.136	.10725	-.2564	-.1264	.208	.05191	-.0918	-.0852	.152	.152	6.592	6.592
Country of Origin	-.014	.02343	-.04435	-.6153	.5393	-.0544	-.0443	-.0480	.980	.980	1.020	1.020
GENDER_NEW	.210	.11452	.1840	.1607	.101	.132	.128	.1708	.748	.748	1.413	1.413
MARTIAL STATUS	-.426	.23709	-.301	-.18073	.0738	-.0929	-.1125	-.1646	.835	.835	6.094	6.094
OCCUPATION_NEW	-.115	.07120	-.123	-.1623	.1068	-.0216	-.113	-.1176	.835	.835	1.142	1.142
QUALIFICATION_NEW	-.003	.05205	-.052	-.062	.9512	-.0504	-.044	-.057	.835	.835	1.167	1.167
ANNUAL INCOME	.188	.06711	.2795	.2795	.006	.16498	.194	.1948	.835	.835	1.179	1.179

a. Dependent Variable: What factors motivate you to adopt product like SBL?

The above table shows that there exists significant relationship between dependent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (factors motivating to adopt SBL)



Consumer Adoption of Smart Biometric Lock Among SAARC Nations

Table 13: Country of Origin * What factors motivate you to adopt product like SBL?						
Cross tabulation						
Count		What factors motivate you to adopt product like SBL?				Total
		Security	Convenience	Low repair cost	None	
Country of Origin	AFGANISTAN	5	14	0	1	20
	BANGLADESH	7	10	1	2	20
	BHUTAN	8	11	1	0	20
	INDIA	28	31	2	0	61
	MALDIVES	7	10	1	1	19
	NEPAL	11	9	0	0	20
	PAKISTAN	10	7	2	1	20
	SRILANKA	7	11	1	1	20
Total		83	103	8	6	200

The above table shows that Indians, Nepalese, Pakistanis prefers security feature over other features whereas other countries prefer convenience features of SBL.

Table 14: GENDER_NEW * What factors motivate you to adopt product like SBL?						
Cross tabulation						
Count		What factors motivate you to adopt product like SBL?				Total
		Security	Convenience	Low repair cost	None	
GENDER_NEW	Female	46	54	4	1	105
	Male	37	49	4	5	95
Total		83	103	8	6	200

The above table shows that females are more concerned about security features in SBL over males.

V. MAIN RESULTS

Results of this research shows that there exists significant relationship between independent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (innovation adoption). The high-income group people are more likely to adopt SBL innovation as compared to low annual income group people. The Indians, Nepalese prefers to adopt SBL more rapidly.

Most of the previous researches have proposed biometric locks which are significantly different from the look of traditional locks whereas this paper presented a biometric lock which is similar in looks and feel of a traditional lock but having all the high-tech modern biometric features. And the results have shown the respondents interest in this product model.

VI. CONCLUSION AND RECOMMENDATIONS

There exists significant relationship between independent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (innovation adoption). The high-income group people are more likely to adopt SBL

innovation as compared to low annual income group people. The Indians, Nepalese prefers to adopt SBL more rapidly.

There exists significant relationship between dependent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (preference of SBL over number lock). There exists significant relationship between dependent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (consider SBL as best option for elders and children's). There exists significant relationship between dependent variables (age, country, gender, marital status, occupation, annual income) and dependent variable (factors motivating to adopt SBL). The Indians, Nepalese, Pakistanis prefers security feature over other features whereas other countries prefer convenience features of SBL. The females are more concerned about security features in SBL over males.

Adoption of SBL can be improved by enhancing its security features as well as reducing the repair costs or offering some limited time free repair facility. Promotion of security features among SAARC nations should be done to increase awareness of this innovative product.

VII. LIMITATIONS OF STUDY & FUTURE SCOPE OF STUDY

- The sample size could be increased to give more realistic view.
- Researcher has used ANOVA as a tool of analysis which has its own limitations.
- Respondents from different nations of SAARC can be classified based on their innovation adoption attitude.
- Data collection methods like interview method can be used to make response more accurate.
- Developed countries (U.S., U.K., Japan etc.) citizens are not covered in survey.

ACKNOWLEDGEMENT

We would like to acknowledge and give special thanks to faculties and students of Amity University, South Asian University, Moscow University, University of Colombo, Kabul University, Bangladesh University, Royal University of Bhutan and Kathmandu University for their help in collecting responses of our research.

REFERENCES

1. Aanchal Jindal, D. P. (2013, December). International Journal of Engineering Research & Technology (IJERT) (12).
2. Alfakhri M. Murshed, K. L. (2018, March-April). Implementation of Enhanced Finger Print based Door Locking System. International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 3(3).
3. Amuda F.A, T. D. (2017, April). Design and Implementation of a Fingerprint Lock System. IOSR Journal of Engineering (IOSRJEN), 7(4).
4. Anaza, S. O. (2017). A Review of Intelligent Lock System. American Journal of Engineering Research (AJER), 09-15.
5. Bhatia, D. (2014, January). A smart door access system using finger print biometric system.



6. DAHE, S. A. (2015). Study conceptual design of biometrics technology in door lock security system. Journal of Kerbala University, Vol. 13 No.3 Scientific, 312-328.
7. Falohun A. S, O. E. (2012). Development of a biometrically- controlled door system (using iris), with power backup. AMERICAN JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.
8. Hussaini, H., Adamu, M. Z, Ajagun, A. S., Ijamaru, G. K. & Oresanya, B. O. (2014): Design of a GSM-Based Biometric Access Control System Control Theory and Informatics, Vol.4(8), pp 1-21.
9. Kawale, A. (2013, May). Fingerprint based locking system. International Journal of Scientific & Engineering Research, 4(5).
10. Komal, K. M. & Dhiraj, G. A. (2015): Campus Access Management System via RFID, International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Vol.4 (8), pp 23-27.
11. Pradnya R. Nehete, J. P. (2016, November). Literature Survey on Door Lock Security Systems. International Journal of Computer Applications , Volume 153 – No2, 18.
12. Priti, K. P. & Zadem, G. N. (2014): Real time Car Antitheft System with Accident Detection using AVR Microcontroller; A Review, International Journal of Advance Research in Computer Science and Management Studies, Vol. 2 (1), pp 509-512
13. Raghu, R. G. & SubhramanyaSarma, G. (2013): Locker Opening and Closing System Using RFID, Fingerprint, Password and GSM, International journal of emerging trends & technology in computer science (IJETTCS), Vol. 2 (2), pp 142-145.
14. Ramani, R., Valarmathy, S., Suthanthira, V. N., Selvaraju, S., Thiruppathi, M. & Thangam, R. (2013): Vehicle Tracking and Locking System Based on GSM and GPS, I. J. Intelligent Systems and Application, (IJISA.), pp 86-93
15. Rouse, M. (2018). searchsecurity.techtarget.com. Retrieved from <https://searchsecurity.techtarget.com/definition/biometrics>
16. Tintu Pious, S. K. (2017, April). Fingerprint Based Automatic Door Lock System . International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 6(4).
17. Vikas Garg, A. S. (2018, January). A Study on transformation in technological based Biometrics Attendance System: Human Resource Management Practice. IEEE ,2018 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence), 809-813.