

Demonetization and Cashless Banking Transactions in India

Arvind Kumar

*Lecturer, Department of Computer Science
K. M. Government (P.G.) College Narwana (Jind), India*

Abstract— Demonetization is every Indian's memorable experience and is going to be one of the economic events of our time. Its impact is felt by every Indian citizen. Demonetization affects the economy through the liquidity side. Demonetizing is Progressive shift to a cashless economy with a greater focus on electronic transactions is being envisaged. Rising use of credit/debit cards, net banking and other online payment mechanisms will be another positive effect of demonetization, as these would not only lower transaction costs but many other benefits as well.

Keywords— Cashless Banking, Economic Growth, Automatic Teller Machine, Demonetization, Point of Sales (POS) terminal.

I. INTRODUCTION

When a currency note of a particular denomination ceases to be a legal tender it is termed as demonetization. It is the act of stripping a currency unit of its status as legal tender. Demonetization is needed whenever there is a change of national currency. It was implemented in India for the third time on the 8th November 2016. Demonetization encourages cashless transactions as when transactions via digital or means increase the amount of money printed decreases and thus reducing the cost of printing as well as black money circulation. An economy whose all transactions are done by cards or digital means can be termed as cashless economy. India has an abundant circulation of the currency notes at over 12% of GDP and of this cash, 87% is in the form of Rs500 and Rs1000 notes. It is far higher than the other countries. Indian government has replaced the old Rs 500 notes with newer ones and doing away with the Rs 1,000 notes. This encouraged cashless transactions by means of credit cards, bank transfers, checks with no bills and coins handed from one person to another. Cashless transactions are done by three modes: MOBILE WALLET, PLASTIC MONEY, and NET BANKING. With increasing adoption of these electronic payments, it also increased e-commerce and m-commerce.

II. LITERATURE REVIEW

Morufu and Taibat, used qualitative survey to ascertain banker's perceptions of cashless instrument in Nigeria banking system. The result suggest that bankers in Nigeria perceive cashless instrument as a tools for minimizing inconvenience, reducing transaction cost, altering customers queuing pattern and saving customers time.

Annamalai, S. and Muthu R. Iiakkuvan (2008) in their article "Retail transaction: Future bright for plastic money" projected the growth of debit and credit cards in the retail transactions. They also mentioned the growth factors, which leads to its popularity, important constraints faced by banks and summarized with bright future and scope of plastic money.

Olajide used theories to investigate cashless banking in Nigeria and its impact on economy, he find out that cashless banking instrument will boost the economy on the long-run.

Alvares, Clifford (2009) in their reports "The problem regarding fake currency in India." It is said that the country's battle against fake currency is not getting easier and many fakes go undetected. It is also stated that counterfeiters hitherto had restricted printing facilities which made it easier to discover fakes.

Jain, P.M (2006) in the article "E-payments and e-banking" opined that e- payments will be able to check black"An Analysis of Growth Pattern of Cashless Transaction System. Taking fullest advantage of technology, quick payments and remittances will ensure optimal use of available funds for banks, financial institutions, business houses and common citizen of India. He also pointed out the need for e-payments and modes of e-payments and communication networks.

Ashish Das, and Rakhi Agarwal, (2010) in their article "Cashless Payment System in India- A Roadmap" Cash as a mode of payment is an expensive proposition for the Government. The country needs to move away from cash-based towards a cashless (electronic) payment system. This will help reduce currency management

cost, track transactions, check tax avoidance / fraud etc., enhance financial inclusion and integrate the parallel economy with main stream.

III. OBJECTIVES OF THE STUDY

The study aims at:

- To study Role of Demonetization in India.
- To examine Status of Electronic Payment Based System in India.
- To examine top cashless countries in the world.

IV. METHODOLOGY

The study is based on secondary sources of data/ information. Different books, journals, newspapers and relevant websites have been consulted in order to make the study an effective one. The study attempts to examine the Cashless Payment System in India.

4.1 Demonetization in India

Demonetization is the act of stripping a currency unit of its status as legal tender. It is the process of ceasing to produce and circulate particular forms of currency. This is necessary whenever there is a change of national currency. The old unit of currency is retired and replaced with a new currency unit. Legal tender is a medium of payment recognized by a legal system to be valid for meeting a financial obligation. It can be anything which when offered in payment extinguishes the debt. Coins and banknotes are usually defined as legal tender whereas personal cheques, credit cards, and similar non-cash methods of payment are not considered legal tender as debt obligations is not relieved until the payment is tendered.

The first was when Rs 1,000, Rs 5,000 and Rs 10,000 notes were taken out of circulation in January 1946, a year half before the country independence from British. The Rs 10,000 notes were the largest currency dominated ever printed by Reserve Bank of India (RBI) introduced for the first time in 1938. All the three notes were reintroduced in the year 1954 and these banknotes were again demonetized in January 1978. Demonetization was implemented in India for the third time on the 8th November 2016 removing 500 rupees and 1000 rupees notes from its status of legal tender leaving the residents of India in shock. The permitted amount of exchange of the old currency notes with the new 500 rupees and 2000 rupees notes was 4000 rupees earlier and gradually increased to 4500 rupees. The withdrawal limit from the banks was initially 20,000 rupees and now its 24,000 rupees.

4.2 Cashless Transactions in Indian Economy

Cash is a costly item as the paper is imported and movement of cash involves expenditure for security and insurance. If people do banking through cheques and net banking all these expenditures can be minimized. Cash transactions should therefore be minimized.

In many developed countries across the world, residents rely more heavily on cashless than traditional currency. But India is a country where 98 percent of total economic transactions by volume are done through cash. However, this may no longer be the case in future as the government has already steered the country towards cash less society. Prime Minister's demonetization move has also divided the top economists in and outside the country over its unquantifiable outcomes, at least for now. Table 1.1 below shows a list of the most cashless nations in the world, based on the percentage of cashless transactions.

Table 1.1 Top cashless countries in the world

1	Singapore	61%
2	Netherlands	60%
3	France	59%
4	Sweden	59%
5	Canada	57%
6	Belgium	56%
7	United Kingdom	52%
8	USA	45%
9	Australia	35%
10	Germany	33%
11	South Korea	29%
12	Spain	16%
13	Brazil	15%
14	Japan	14%
15	China	10%
16	India	2%

Source: Mastercard Advisor's Measuring progress toward a cashless society

4.2.1 Advantages of Going Cashless

- The recent waiver of service tax on card transactions up to Rs 2,000 is one of the incentives provided by the government to promote cashless transactions.
- If all transactions are on record, it will be very easy for people to keep track of their spending and this will result in better budgeting. It will also help while filing income tax returns.
- If stolen, it is easy to block a credit card or mobile wallet remotely, but it's impossible to get your cash back.
- It can curb the black money.
- Huge amount of money is spent on cash creation and transportation. This can be avoided.
- It helps in implementing welfare schemes more effectively because the fund is directed directly to the beneficiaries account. The role of middlemen can be reduced
- Will reduce real estate price because most of the transaction in real estate is done through black money
- The speedy transaction which in turn helps more vibrant economic activities.
- Reduced the cost of maintaining ATM
- Ill effects of fake currency can be eliminated. As in country one in seven notes that are circulating is fake, which has an adverse effect on the economy.
- When India become cashless sponsored terrorism will take a back seat.
- The ease of conducting financial transactions is probably the biggest motivator to go cashless.
- GO DIGITAL, GET DISCOUNTS
 - Service tax: Waiver of service tax of 15% on digital transactions up to 2,000.
 - Fuel: 0.75% discount on digital purchase of fuel through credit/debit cards, E-wallets or mobile wallets.
 - Rail tickets: 0.5% discount on monthly and seasonal suburban railway tickets from 1 January 2017. Online rail ticket buyers get up to `10 lakh free accident insurance too.
 - Rail catering: 5% discount on digital payments for railway catering, accommodation, retiring rooms, etc.
 - Highway toll: 10% discount on NH toll payment via RFID or fast-tags in 2016-17.
 - Insurance: 10% discount by government general insurers on premium paid online via their portals. 8% discount on new LIC policies bought online via its site. POS: Rs 100 a month is the maximum rent that PSU banks can charge for PoS terminals.
 - Rupaya: Kisan credit card holders to get RuPay Kisan cards.

4.2.2 Drawbacks of Cashless Transactions

- Cyber attack, fraud and power outage
- Cyber security
- Less paper cash means bad for certain sector
- Losing phone

4.2.3 Challenges of Making India Cashless

- Low Network connectivity
- High Internet cost
- Not everyone can Afford a costly Smartphone
- Lack of technical knowledge/Un-educated people
- Internet blockage
- Not enough bank accounts: Most people still do not have bank accounts.
- Increasing cyber crimes.

4.3 How is Indian Payment System Infrastructure?

- India has seen a rapid disintermediation of the payments system that was once restricted to only banks and their traditional clearing facilities.
- Entrepreneurs abound in the recent digital payment interfaces such as prepaid instruments like mobile wallets.
- These will replace the traditional clearing systems such as RTGS (real time gross settlement) as also online facilities provided by banks and telecom companies.
- Unified Payments Interface is in itself a game changer and only banks have been allowed by the Reserve Bank of India (RBI) to become payment service providers keeping wallets and other prepaid instruments out, thus giving a boost to banks in the race to secure a big slice of the payments pie.

4.4 Demonization Effect on Electronic Payment System

Over the years, various studies have documented how countries could benefit moving from cash to digital payments. The government of India also aims to achieve the target of moving towards complete cashless so that the employees, students and other educated people of India may be enabled to make cashless payments in respect of transactions like deposit of fees, buss pass, fines etc. and also to make purchases through various modes like debit/credit card, e-wallets, UPI, USSD and other online banking facilities.

But doing so is not easy for Indian government. Cashless transactions have their downsides for consumers. But, for those with access to digital payments, rejecting cashless options or hesitating to embrace technology is also not the answer, especially in the wake of the cash crunch brought on by the government's demonetization move. Questions of access aside, a cashless world has its benefits. Embracing cashless options and being an informed consumer who is aware of the available systems and their designs increases the chances of a convenient and consumer-friendly experience.

Traditionally, online transactions were done either by providing debit and credit card details or through net banking interfaces. While there were issues of security, which kept improving, the payment experience was not very user-friendly. These options were also largely restricted to computers with access to internet. But after the Smartphone revolution, things have changed entirely. India has seen an explosion in digital payment options, from e-Wallets to the Unified Payment Interface to a combination of the two. There are many cashless payment options available in India. Some best cashless payment options in India are as follows:-

4.4.1 POS –

The point of sale or point of purchase (POS) is the time and place where a retail transaction is completed.

Types of POS machines are

- Physical POS
- Mobile POS
- V-POS

4.4.2 E Wallets –

E-Wallets or Mobile wallets are essentially digital versions of traditional wallets that a person would carry. While there are many variations, usually they can hold digital information about credit and debit cards for making payments, store coupons and loyalty programs, specific information about personal identity and more. A lot of companies have started to prefer this mode of cashless transaction for both receiving as well paying.

E Wallets have become very famous nowadays. After demonetization, use of e wallets has been implemented at a very large-scale. These e wallets allow users to make payments using your mobile number or by scanning a QR code which takes place in a jiffy. All you need to do is simply download a wallet like paytm, USSD etc.

UNSTRUCTURED SUPPLEMENTARY SERVICE DATA (USSD):

How to use USSD?

1. Link your mobile number to your bank account.
2. Dial *99# from your phone.
3. Fill in the first 3 letters of your bank against Short Name or first 4 letters of Indian
4. Financial System Code (IFSC).
5. Choose 'Fund-Transfer Mobile Money Identification Number (MMID)' option.
6. Enter the payee's mobile number and MMID.
7. Enter the amount and your Mobile Banking Personal Identification Number (MPIN), leave a space and enter the last 4 digits of your account number.
8. The USSD is an initiative by the Government of India. It is a form of Mobile Wallet. It makes cashless transaction easy for all sectors of people.

4.4.3 UPI –

UPI also known as Unified Payments Interface is another great way to go cashless. Unified payments interface also called UPI is system of payments. UPI was launched by NPCI with the Reserve Bank of India's (RBI) vision of migrating towards 'less-cash' and more digital society. UPI was built on IMPS platform. Using unified payments interface, people can transact using their smart phones. To pay using this system called unified payments interface, you need following important things:

Requirements for UPI.

Table 1.2: Requirements for UPI

Requirements for UPI	Available APPS
- Smartphone with internet facility - Bank Account Details (only for registration)	SBI, PNB, UPI Collect, ICICI, Axis Pay, Canara Bank, UCO UPI, Union Bank UPI, OBC UPI and other Banks

IMMEDIATE PAYMENT SERVICE (IMPS):

Immediate Payment Service is a real time interbank electronic fund transfer system of India. IMPS offers an interbank electronic fund transfer service through mobile phones. Unlike NEFT and RTGS it is available all through the year 24/7 including bank holidays. It is managed National Payments Corporation of India (NPCI).

4.4.4 Plastic Money –

Plastic Money means debit cards and credit cards that are used at ATM's for cash withdrawal. Having a debit or credit cards make you burden free from carrying cash. Here transactions take place on the basis of credit and debit. In case of credit cards payment is made after the purchase of goods. In case of debit cards payment is made by debiting amount from one's bank account directly. In case of other prepaid cards the amount is already paid in the card before purchase or use of the card for usage.

Table 1.3: Types of Cards & Usage

PREPAID CARDS	DEBIT CARDS
<ul style="list-style-type: none"> ○ Pre-loaded from your bank account ○ Safe to use, limited amount of transaction ○ Can be recharged like mobile recharge 	<ul style="list-style-type: none"> ○ Linked to your bank account ○ Used to pay at shops, ATMs, wallets, micro ATMs, online shopping

4.4.5 Net Banking –

Net Banking is another handy way to get cashless transactions done. All you need is a bank account with e banking facility enabled on it. You can transfer funds to others account from the comfort of your home. There is no need of going to your bank to get transfers done. It avoids the queue and delay in the banks. It saves a lot of time and energy. It is a secure way of banking. You can make all payments and transfers yourself. This is a very convenient way to go cashless in India as well. Various methods of net or electronic banking are, National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS), Immediate Payment Service (IMPS) etc,

There are various misconceptions on cashless transactions on account of personal information being misused. There are various laws which prevent cyber contravention. Cyber contravention deals primarily with unauthorized access to computer, computer system or computer network. Cyber Contravention is subject to civil prosecution and proceedings. Penalty of cyber contravention is to pay for the damages and compensation not exceeding one crore rupees.

4.4.6 Aadhaar Card –

Aadhaar Card enabled payment system (AEPS) allows a person to pay using his aadhaar card if it is linked to his bank account. Once you link your aadhaar card to your bank, you can make payments using your finger prints. This system of getting money neither requires your signature nor Debit card. You don't even need to visit a bank branch for getting money through the Aadhaar Enabled Payment System. Rather, it uses Aadhaar data for the authentication. At the time of Aadhaar enrolment, your fingerprints and iris image were taken. These biometric data gets linked to the given Aadhaar number. These were taken. These biometric data gets linked to the given Aadhaar number. These biometric data is unique to a person. No two person have the same iris image or fingerprints. Thus, your Aadhaar number can be verified by your finger prints. This biometric authentication makes Aadhaar the perfect proof for the banking transactions. Indeed, It has replaced the signature.

Requirements for AEPS:

Through the Aadhaar Enabled Payment System, you can get money without producing any paper or card. However, your Aadhaar number should be registered with your bank account. If you did not linked your Aadhaar with a bank account the Aadhaar Enabled Payment System would not be useful to you. For AEPS transaction, you need following information.

- Aadhaar Number
- Bank IIN or Name
- Fingerprint

It means, you have to only remember your Aadhaar number to do the bank transaction. It is just like remembering own mobile number.

Benefits of Aadhaar Enabled Payment System

- You can perform financial and non-financial transaction through the banking correspondent.
- A banking correspondent of any bank can do the specified transaction of any bank.
- There is no need of signature or debit card.
- It is fast and secure. No one can forge your fingerprint.
- Banking correspondent can reach to the distant rural place with the micro POS.

Table 1.4: Electronic Payment System – Representative Data

Electronic Payment Systems - Representative Data (Updated as on December 31, 2016)																							
Data for the period	Volume in million, Value in Rs. billion																						
	RTGS		NEFT		CTS*		IMPS*		NACH*		UPI*		USSD*		Debit and Credit Cards at POS*		PPI #		Mobile Banking		Total		
	volume	value	volume	value	volume	value	volume	value	volume	value	volume	value	volume (in thousand)	value (in Rs. thousand)	volume	value	volume	value	volume	value	volume	value	
Nov-16	7.9	78479.2	123.0	8807.8	87.1	5419.2	36.2	324.8	152.5	606.4	0.3	0.9	7.0	7302.6	295.5	352.4	59.0	13.2	72.3	1244.9	671.5	94004.2	
Dec-16	1	0.3	3781.0	10.4	564.6	4.6	288.4	1.8	11.2	11.6	55.7	0.0	0.1	1.0	943.4	8.6	14.6	2.5	0.6	2.8	49.3	35.9	4723.5
	2	0.3	3784.7	7.7	466.6	4.4	265.5	1.7	15.4	9.4	34.5	0.0	0.1	1.2	1349.9	8.9	15.3	2.6	0.6	2.6	89.1	35.1	4564.1
	3	0.3	706.0	6.4	272.9	4.7	231.4	1.7	15.0	6.2	15.3	0.0	0.1	1.4	1413.9	10.0	17.4	2.7	0.6	2.6	26.3	32.0	1258.6
	4	h	h	h	h	h	h	1.2	3.0	h	h	0.0	0.1	1.1	1198.2	9.9	15.3	2.5	0.6	2.0	11.5	13.6	24.9
	5	0.3	3552.4	7.0	459.2	4.9	247.2	1.9	15.5	15.0	64.0	0.0	0.1	0.9	1076.3	10.5	17.5	2.7	0.6	2.5	43.8	42.4	4357.4
	6	0.3	3630.4	6.0	350.1	4.6	222.7	1.7	14.0	18.2	21.1	0.0	0.1	0.8	943.3	9.2	16.0	2.6	0.6	2.5	71.9	42.6	4254.9
	7	0.3	3300.7	7.2	399.0	5.2	256.4	1.8	15.5	13.5	32.0	0.0	0.2	1.3	1358.0	9.8	17.2	2.7	0.7	2.6	44.3	46.5	4021.9
	8	0.3	3151.8	6.9	417.1	5.1	256.6	1.8	15.4	6.0	29.9	0.1	0.1	1.8	1740.3	6.5	12.0	2.5	0.6	2.5	40.2	25.2	3883.5
	9	0.4	4329.5	7.1	473.6	4.8	277.5	1.8	15.3	6.0	17.3	0.1	0.2	2.5	2220.7	10.1	17.0	2.7	0.7	2.3	48.5	33.0	5131.1
	10	h	h	h	h	h	h	1.5	11.6	h	h	0.0	0.1	1.4	1509.0	10.0	16.6	2.7	0.7	1.9	12.5	14.3	29.0
	11	h	h	h	h	h	h	1.0	5.5	h	h	0.0	0.1	1.5	1355.6	9.5	13.8	2.7	0.7	1.8	9.2	13.3	21.1
	12	0.2	297.2	5.3	230.5	2.4	134.8	1.4	11.2	14.0	46.5	0.1	0.2	2.2	1820.6	11.4	19.1	2.8	0.7	2.1	17.5	37.4	739.1
	13	0.4	3484.4	6.4	488.7	5.6	294.4	1.8	13.9	5.5	13.6	0.1	0.2	2.4	2388.2	9.9	15.3	2.8	0.7	2.2	47.5	32.5	4511.5
	14	0.4	3818.4	6.7	487.7	6.5	320.4	1.9	15.5	4.9	23.1	0.1	0.3	1.9	2200.4	9.6	15.4	2.9	0.7	2.3	45.0	33.1	4682.0
	15	0.4	4419.4	6.0	495.3	6.1	292.2	1.9	15.6	6.0	47.2	0.1	0.3	2.3	2553.7	9.5	15.5	2.6	0.7	2.4	45.8	32.5	5286.2
	16	0.4	3213.2	5.8	415.2	6.0	297.2	1.9	15.0	4.5	13.7	0.1	0.3	3.4	3432.9	6.0	11.0	3.1	0.8	2.3	79.1	27.8	3965.3
	17	0.3	707.0	4.9	250.1	5.3	252.4	1.7	13.2	5.6	8.5	0.1	0.3	3.6	3879.1	6.5	12.9	3.0	0.8	2.3	24.2	27.3	1245.0
	18	h	h	h	h	h	h	1.1	6.6	h	h	0.1	0.1	3.4	3489.4			2.8	0.7	1.7	7.4	4.0	7.4

Source : NPCI

Source : NPCI National Payments Corporation of India (NPCI is pleased to announce that there has been an impressive surge in the usage of cards at Point of Sale (PoS) terminals at shops and other retail outlets. During (November 9 and 10, 2016), Cards usage on PoS / e-Commerce was around 8 lakh transactions a day compared with a daily average of 4 lakh transactions earlier. The value of transactions almost doubled. Mr. A. P. Hota, MD & CEO, NPCI said, “It is heartening to witness a good number of first time users at PoS terminals. Using the PoS is even simpler than using on ATM. When there are restrictions on withdrawal of cash in the aftermath of demonetization of notes, usage of payment cards at PoS for all day-to-day purchases is the ideal way to transact.” Immediate Payment Service (IMPS) and Unified Payments Interface (UPI) usage has doubled. IMPS and UPI are 24x7 remittance service. India has 14 lakh PoS terminals and all the terminals accept all brands of debit and credit cards.

IV. CONCLUSION

The cashless transaction system is reaching its growth day by day , as soon as the market become globalised and the growth of banking sector more and more the people moves from cash to cashless system. The cashless system is not only requirement but also a need of today society. All the online market basically depends on cashless transaction system. The cashless transition is not only safer than the cash transaction but is less time consuming and not a trouble of carrying and trouble of wear and tear like paper money. It also helps in record of the all the transaction done. So, it is without doubt said that future transaction system is cashless transaction system.

REFERENCES

- [1] James, A.O. (2012). The acceptance of E-banking by customers in Nigeria. *World review of Business Research*, 2(2), 6-8.
- [2] B. Corona, M. Nakano, H. Pérez, "Adaptive Watermarking Algorithm for Binary Image Watermarks", *Lecture Notes in Computer Science, Springer*, pp. 207-215, 2004.
- [3] Olajide, V.C., 2012. Cashless banking in Nigeria and its implication, 1-8 retrieved online Olatokun M. and Igbineduon L. (2009). The adoption of automatic teller machine in Nigeria: an application of theory of diffusion of information.
- [4] Newstead, S., 2012. Cashless payments underpin economic growth. Building Tomorrow. Rbs.com/insight.
- [5] A. A. Reddy and B. N. Chatterji, "A new wavelet based logo-watermarking scheme," *Pattern Recognition Letters*, vol. 26, pp. 1019-1027, 2005.
- [6] Manpreet Kaur, "Demonetization: Impact on Cashless Payment System" 6th international conference on Recent Trends in Engg. Science and Mgt. on 8th Jan 2017 ICRTESSM-17
- [7] J. Ugwu Okereke, "Cashless Banking Transactions and Economic Growth of Nigeria", *Middle-East Journal of Scientific Research* 24 (11): 3576-3581, 2016 ISSN 1990-9233 © IDOSI Publications, 2016
- [8] P. S. Huang, C. S. Chiang, C. P. Chang, and T. M. Tu, "Robust spatial watermarking technique for colour images via direct saturation adjustment," *Vision, Image and Signal Processing, IEE Proceedings* -, vol. 152, pp. 561-574, 2005
- [9] F. Gonzalez and J. Hernandez, "A tutorial on Digital Watermarking", In *IEEE annual Carnahan conference on security technology*, Spain, 1999.
- [10] D. Kunder, "Multi-resolution Digital Watermarking Algorithms and Implications for Multimedia Signals", Ph.D. thesis, university of Toronto, Canada, 2001.
- [11] J. Eggers, J. Su and B. Girod, "Robustness of a Blind Image Watermarking Scheme", *Proc. IEEE Int. Conf. on Image Proc.*, Vancouver, 2000.
- [12] Barni M., Bartolini F., Piva A., Multichannel watermarking of color images, *IEEE Transaction on Circuits and Systems of Video Technology* 12(3) (2002) 142-156.
- [13] Kundur D., Hatzinakos D., Towards robust logo watermarking using multiresolution image fusion, *IEEE Transactions on Multimedia* 6 (2004) 185-197.
- [14] C.S. Lu, H.Y.M Liao, "Multipurpose watermarking for image authentication and protection," *IEEE Transaction on Image Processing*, vol. 10, pp. 1579-1592, Oct. 2001.
- [15] L. Ghouti, A. Bouridane, M.K. Ibrahim, and S. Boussakta, "Digital image watermarking using balanced multiwavelets", *IEEE Trans. Signal Process.*, 2006, Vol. 54, No. 4, pp. 1519-1536.