

# E-Governance of Currencies

Innovative ideas pave the way for efficient and seamless governance in any type of organization. Transparency and compliance, coupled with the ability to gather relevant and accurate data, lead to efficient governance by a government. This sort of governance is interdependent and is most effective when it is in evidence from the top of the government to the bottom. A well-governed government will have better governed private and public sectors and so on. If there is a good approach to facilitate the participation of the people at the micro level with the people at the macro level in the government, it is possible to achieve effective governance.

Currently, most financial transactions are either in electronic form or in cash (fiat currency), of which cash contributes to 85 percent of the consumer transactions in the world.<sup>1</sup> Government can obtain access to the information on all forms of electronic transactions, but is unable to obtain data on currency after it moves from a central or local bank. What if government were able to access information on currency transactions/movements?

If this were possible, it would facilitate achievement of a very high level of transparency and compliance in governance by the government.

Virtual currencies, such as cryptocurrencies, are popular because of their highly secure and transparent nature. This has caused governments throughout the world to give serious thought to adopting virtual currencies to replace some of their cash and electronic transactions. One step in this direction is leveraging the power of participation by having people use their smartphones to scan a Quick Response (QR) code on fiat currency notes, which will bring to those notes much-needed security and tracking capabilities.

## Brief Outline of the Proposed Idea

Using a central bank-provided application (app), the smartphone user will scan a unique encrypted QR code on a currency note to check its authenticity

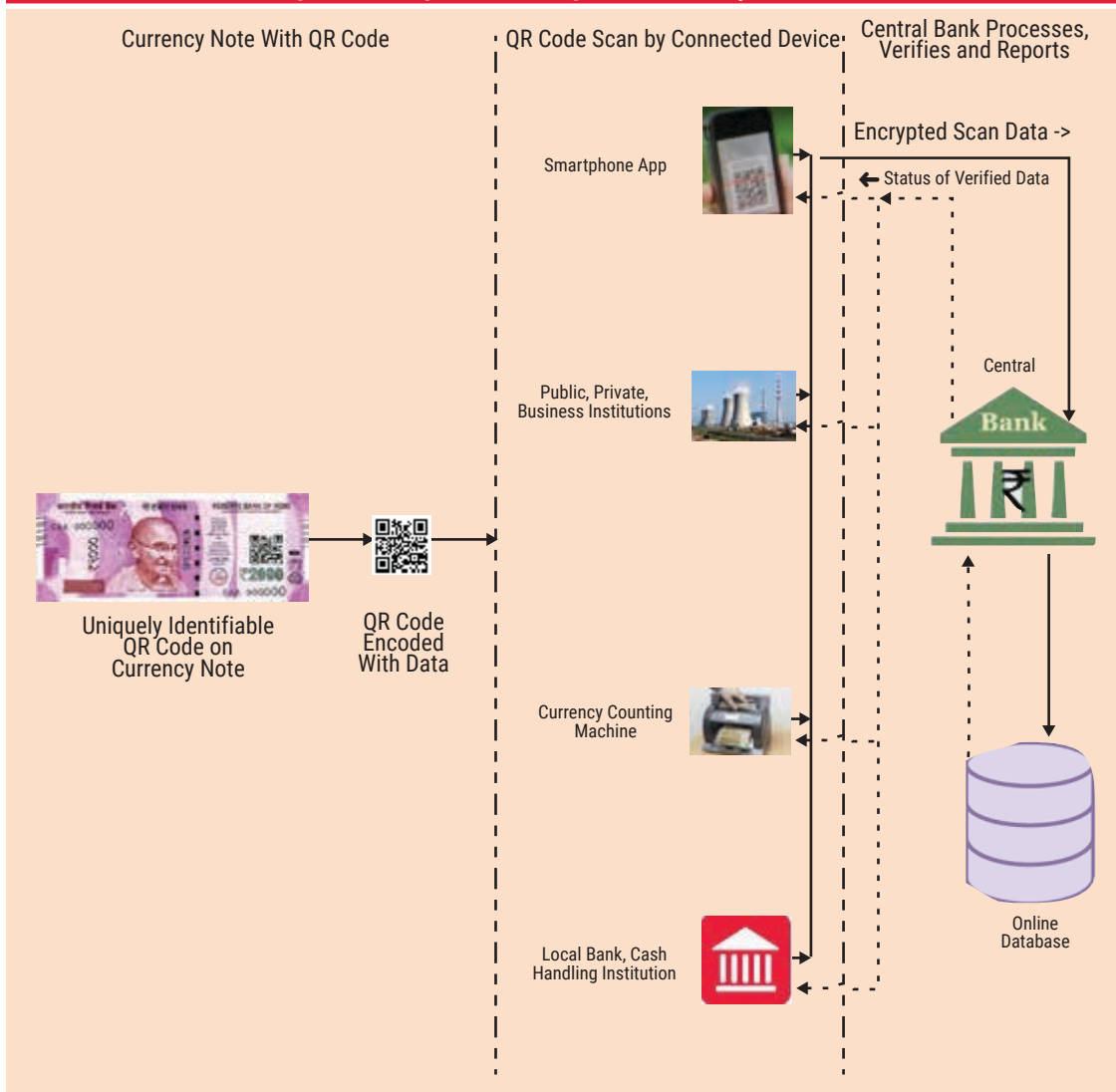


online. The central bank online database and software supporting the application will be capable of decrypting the scanned data from the encrypted QR code to identify and report the genuineness of the currency note. Extending this further, the central bank can establish mutual authentication with all such devices (e.g., currency counting machines, automated teller machines [ATMs] and cash deposit machines [CDMs]). All machines involved in handling or checking currency notes will be QR code-enabled and registered with the central database (**figure 1**). Connecting to the database enables the individual to effectively identify, revoke, tag or track the currency notes in real time, online.

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**Figure 1—Complete Flow Diagram of Currency Validation**



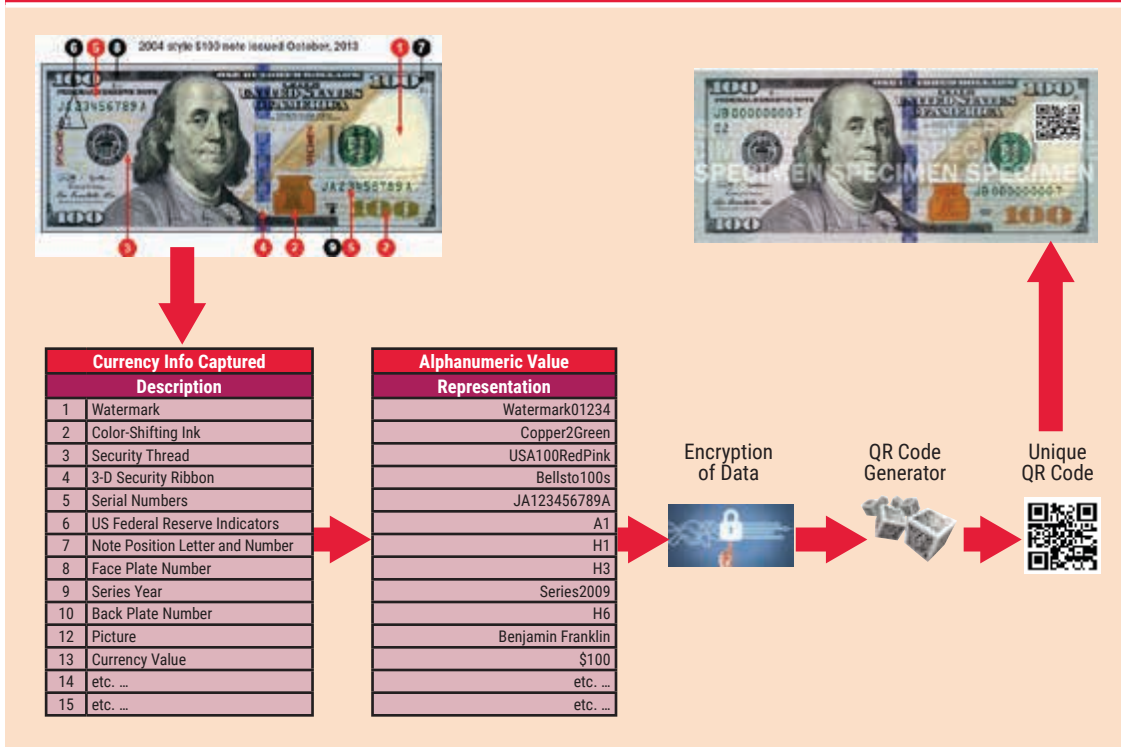
## QR Code Design

Very recently, currency notes have had a QR code printed on them only to redirect users to the central bank's website to provide information on the security features of those notes.<sup>2</sup>

In the proposed QR code design, each currency note would have a QR code that is unique and encrypted with enough information (data) about the currency note's details to accurately authenticate it. Information that can be taken from the currency note includes serial number, security features incorporated, currency value, year of print, printing press used, picture used and governor's signature, which can be combined and encrypted into a QR code to make it unique, as shown in **figure 2**.

“ EACH CURRENCY NOTE WOULD HAVE A QR CODE THAT IS UNIQUE AND ENCRYPTED WITH ENOUGH INFORMATION (DATA) ABOUT THE CURRENCY NOTE'S DETAILS TO ACCURATELY AUTHENTICATE IT. ”

**Figure 2—Generation of an Encrypted Unique QR Code**



The details about each currency note<sup>3</sup> are converted into standard alphanumeric values representing each piece of the information, with appropriate lengths, which are then combined and encrypted before being encoded in the QR code format.

## Understanding QR Codes

There are many encryption techniques available to encrypt data into QR codes, starting from a simple symmetric or asymmetric encryption to a complex double-random-phase encryption.<sup>4</sup> QR codes' characteristics that make them very suitable for being used in secure authentication are their capability of storing a large amount of data, reliable error correction at high speed and quick response time.<sup>5</sup>

## Back-End Database Functionality

The central bank online database that supports the smartphone app and various other currency notes handling devices should be able to achieve, at a minimum, the following functions:

- Decryption of the scanned QR code encoded data received from all the devices

- Identification of counterfeit currency notes and notification to the appropriate devices
- Revocation of specified currency notes using a distinct status code that notifies the devices. These would include blocked or temporarily banned notes, perhaps because they are being used for illegitimate purposes.
- Tagging of currency notes, with or without the facility to tag it, at the device level with a unique code. This feature will help in identifying the current owner of the currency. It can be used in detecting bribery, identifying owners of stolen cash, etc.
- Mutual authentication between the devices and the central database.<sup>6</sup> To leverage online, real-time verification of currency notes, all connecting devices should be registered, with unique identification. Smartphones may be identified and authenticated with their mobile numbers.
- Recording of all the currency notes scanned from each device, with details of the device and the currency notes

Currently, the advanced currency note counting devices deployed check the genuineness of the note based on the note's security features using light and image-based technology (ultraviolet, infrared and magnetic sensors).

“AT PRESENT, THERE ARE NO KNOWN MECHANISMS TO TRACK AN INDIVIDUAL CURRENCY NOTE, ALTHOUGH THE SERIAL NUMBER IS PRESENT ON EACH NOTE.”

### Tracking Currency Notes

After currency notes are printed and issued from the central bank's printing press, they are counted and checked for their total, in value and in number. At present, there are no known mechanisms to track an individual currency note, although the serial number is present on each note.

With a QR code on currency notes, each note can be uniquely identified and tracked at almost every stage in its movement, from the central bank to the local bank and further, all the way to its end users. Smartphone users will participate in this tracking process by scanning notes now and then to ensure that they do not end up with counterfeit notes. Every currency note whose QR code is scanned from a device (mutually authenticated) will be validated and recorded in the central database.

This capability to track every single unique currency note by its location or its user will ultimately bring accountability and transparency that are hitherto lacking in the present financial scenario. Various

benefits that could accrue to the government and its users from this approach may be briefly summed up as follows:

- Facilitating the identification of counterfeit currency notes using smartphones and supported devices
- Facilitating the government's and banks' online reconciliation of currency notes in circulation. It will also help in assessing the amount of new currency to be printed in the future.
- Enabling the government to identify the location of hoarded currency and currency that has not come into devices for scanning for an unduly long period of time
- Enabling the government to estimate the amount of currency handled by various sectors of the economy
- Providing valuable information to the government to effectively plan for demonetization/ remonetization based on data about the volume of currency spread over various demographics
- Providing information to the government on the volume of destroyed and soiled currency
- Helping the government revoke currency notes that are stolen from banks, ATMs or CDMs, or currency being used for unlawful activities

This list is not exhaustive. Various other benefits could also accrue, given the rapid strides that technology is taking at present.

### Conclusion

The number of smartphones and their expanded usage have increased exponentially in developed and developing countries, giving rise to a unique opportunity to harness technology and reach out to the citizenry. The approach described herein can also greatly facilitate achievement of a cashless economy and eradicating the use of currency for illegitimate purposes such as terrorist funding, scams and frauds. Ultimately, the result will be better governance at all levels of the economy.

## Endnotes

- 1 Thomas, H.; "Measuring Progress Toward a Cashless Society," MasterCard, <https://www.mastercardadvisors.com/content/dam/advisors/en-us/documents/MasterCardAdvisors-CashlessSociety.pdf>
- 2 The Central Bank of the Russian Federation, "The 2000-Ruble Bank of Russia Note," [https://www.cbr.ru/eng/Bank-notes\\_coins/banknotes\\_itm/?PrtId=banknotes\\_itm&nominal=2000](https://www.cbr.ru/eng/Bank-notes_coins/banknotes_itm/?PrtId=banknotes_itm&nominal=2000)
- 3 US Currency Education Program, "\$100," <https://www.uscurrency.gov/security/100-security-features-2013-present>
- 4 Markman, A.; B. Javidi; M. Tehranipoor; "Photon-Counting Security Tagging and Verification Using Optically Encoded QR Codes," *IEEE Photonics Journal*, vol. 6, iss.1, February 2014, <http://ieeexplore.ieee.org/document/6685832?reload=true>
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- 6 Kim, H.; K. Shin; "Weakness Cryptanalysis of Liao's Scheme and Improved Remote User Authentication Scheme for Mobile Device," *International Journal of Security and Its Applications*, vol. 8, no. 5, September 2014, [https://www.researchgate.net/publication/286858686\\_Weakness\\_Cryptanalysis\\_of\\_Liao's\\_Scheme\\_and\\_Improved\\_Remote\\_User\\_Authentication\\_Scheme\\_for\\_Mobile\\_Device](https://www.researchgate.net/publication/286858686_Weakness_Cryptanalysis_of_Liao's_Scheme_and_Improved_Remote_User_Authentication_Scheme_for_Mobile_Device)