BGPS: a banknote global position system for counter forgery, taxation ratification, money laundry and overall monetary modeling

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Abstract.—The GBPS paper banknote scanning and tracing system integrates money scanner, advanced OCR software, huge database and money stacker output to a viable banking system. With simple Web and SQL queries we support advanced real life applications like counter forgery, stolen money guarantee, taxation ratification, money laundry and overall monetary modeling. The system is closer to an invention than to pure academic development while it currently runs pre alpha tests.

Keywords—Scanner, OCR, System Analysis, ATM.

I. INTRODUCTION

Electronic money gained enormous attention recently but it cannot fulfill the needs of the global economy. Our e-driven world needs redirection and even redefinition in some aspects. Current research areas are:

- Banknote money
- Forgery, Optical character recognition
- Money velocity theory and systems
- Taxation and similar information systems

We investigated a limited number of developments because our research was more close to a patent than to pure academic mathematic development.

A. Banknote money

The examination of banknote money has come to many conclusions as far as banknote’s forgery is assumed. Gilgas Avoine suggested a scheme depending on cryptography, using devices, which are now used in several items, to secure protection from fraud. He takes into consideration any ways that can compromise the privacy of the banknotes’ bearers [1]. A dissertation study proposed a preliminary system based on existing ATM banking technology [2].

Dennis Kugler was engaged with anonymous payment methods, such as banknotes, concluding that anonymity doesn’t actually occur, for the fact that banknotes have a printed serial number. He shows that banks can observe their customers acts in spending money. He assumes that every bank has a database, where all withdrawals and depositions are placed and can be checked and therefore can be useful on courts for economic crimes. His suggestion in order to protect the customers is paying attention to every economic move[3].

A book printed in 1771 shows in a literal way, written in proza style the circulation of money. In that a banknote “speaks” in first person retailing its long story started in the hands of a captain, whose adventures are described, to many more [4].

B. Forgery, Optical character recognition

In China they give much consideration in protection against forgery, by proposing a more secure method, apart from the use of digital signature algorithms and integrated circuit chips, which consists on banknote print-data editing, key management, signing-code injection, and signing-code verification. A description of every method follows, as well as an analysis of how secure and effective every one of the methods is. In conclusion they propose the same anti-forgery system in passports in order to prevent terrorism [5].

At the Carnegie Mellon University a study took place on the countermeasures against government forgery considering physical cash. It concluded that it is vulnerable to rising threats as governmental ones A study was made on the combination of physical with digital cash [6].

A worry rose also for bank cheques. Until recently the main concern was the automation of reading the cheque amount but...
today the most important thing is the deeper analysis of
depth of cheque content in order to prevent cheque fraud [7].
Nikolai Gorski was occupied with the same matter. He proposed using inductive learning algorithm to recognize a
banknote. The technique was tested with great results [8]. Recogniform Technologies SpA invented a device that reads
banknotes serials even in great amounts [9].

C. money velocity theory and systems
The neoclassical monetary business cycle model is examined within endogenous growth finding that money and
credit shocks give an explanation of the varieties in velocity. Endogenous growth is the basic element of money and credit shocks [10].
Comparing high and low Inflation countries it showed that the velocity of money changes in response to endogenous fluctuations in the interest rate [11]. In the US an evaluation of inflation forecasts for 1994-2002 Concluded that nonlinear models produce better forecasts and velocity reduces forecast error [12].
Another paper tests the Friedman hypothesis which assumes that money supply volatility Granger-causes velocity, by comparing the simple-sum and Divisia velocity series. It is found that the Friedman hypothesis is right.[13].Another important monetary aspect is the circulation and velocity of money. In China they presented a statistical formulation of the circulation velocity of money, which depends on the share of exchange and number of agents. They also demonstrated the shape of the holding time distribution[14]. In a meeting of the American Economic Association they concluded that the rise in prices attributes to the pull of demand and also, detected the causations in inflation [15].

D. Taxation and similar information systems
The foreign aid-public investment hypothesis is tested with the use of data taken from India. It is found that the relationship between taxes and government investment in the presence of aid is negative, although grants and loans generally go into development projects with no leakages into consumption [17].

Omar Issing in his analysis of the role of money in monetary policy-making concluded that all banks analyse monetary developments use similar tools and techniques but it is necessary to improve them [18].

More recently a research team in West Macedonia [21] analysed the banknote circulation for their work in a
community currency. It concerned a money information system backed up with Euro banknotes with one month valeur.

E. Bank note Global Position System
Every bank knows in exact dimensions the electronic money velocity and circulation. They use algorithms to
calculate all relevant investment and monetary figures. One artifact is that they are lost in their own monocracy and
despotism. They create internal money exceeding several times the power given to them violating any ethic and law. They do not actually to co-operate in any technological and legal progression.

However there are dimensions not covered or not examined so far:
- Interbanking and Eurogroup global Coverage.
- Banknote universal tracing
- Real money velocity

Our research subject was to prepare a system with advanced banknote processing features:
- Scan and identify the paper banknote money.
- Store every one of them in a universal unique id in
- A huge database
- And perform various queries-activities.

We investigated the following temporary names for our system and we choose the first:
- BGPS, Bank note Global Position System
- euroATM, to denote the strong relationship with banknotes and the European Banking system.
- MIS, MONEY information system denoting the equivalence of money and information.

II. BGPS, THE SYSTEM

The Banknote Global Position System (GBPS) has 5 subsystems:
1. The bank note scanner.
2. The Optical Character recognition software.
3. The banknote database.
4. The paper money stacker.
5. Four banking expert system type operations.

- Counter forgery
- Stolen banknotes
- Taxes ratification
- Money laundry
- Monetary modeling

Our system is feasible, operable and cheap. However its beta test and the wider use is subject to the willingness of our banking system and government persuasion. The cost is the last thing to bother with.
A. The bank note scanner.

In the initial stage of our system there is a modified or plain money scanner with technical specifications like:
- Automatic feed with different size (and value) banknotes
- High resolution one stage scanning.
- Very fast durable operation.
- Modified output

During this stage the banknotes are fed manually into the money scanner. Every one of them is scanned.

B. The Optical Character recognition software.

We tested a variety market OCR software programs with a variety of results. For security reasons these results and software packages will not be announced yet.

The scanned image is fed into the software with features:
- Recognition of banknote serial number
- automatically anywhere on the image,
- independent of skew, orientation and flipping.
- Amount recognition of the banknote.
- Preliminary Forgery analysis.

C. The banknote database.

The software output is stored in the banknote database with the following money record layout schema:
- banknote number
- amount
- GIS data
- Time and date of the transaction.
- Bank ID
- IBAN deposited to
- Transaction number
- Record level encryption techniques.

These data is stored for eternity in a huge database available partially to various authorities.

D. The paper money stacker.

The banknote from the scanner normally is collected by the bank clerk to the cashier’s drawer. An alternative device could be an ATM style money stacker. All money, after scanning, are stored into seven stackers one for each banknote (5, 10, 20, 50, 100, 200, 500 Euro). The device is locked and sealed like an ordinary ATM. A Bank clerk performs all necessary teller operations and it reads the final warning computer message: “the amount of 8970 € will now be delivered to the customer, 80X100, 19X50, 1x20". Then all these banknotes are delivered automatically to the customer without any other human intervention.

III. APPLICATIONS

A. Counter forgery

One common forgery procedure is to falsify a single banknote and copy it several times. Such an item sooner or later it reaches the bank. With our system it is scanned, verified and stored accordingly. After this initial procedure when another banknote with the same serial number appears anywhere inside the European Union it is reported as forged. The action that is followed varies from a possible forgery to a massive attack to the Euro currency.

B. Stolen banknotes

Every EURO banknote in the market from the one billion in use today is traceable by our system. Therefore any illegal banknote holder is by definition a possible thief.

Every day in European Union thousands of bank thieves steal several million Euros. Until now the cost to locate these thieves was very high. The most common incident is like this:

A citizen withdraws from its bank account or ATM few hundred Euros. The next moment or a week later a thief steals the money. The citizen reports the episode to the police. From
this moment every one of the stolen banknotes are under investigation. The next time they appear in a bank deposit the software traces back the money history and reports a variety of messages in the bank cashier computer monitor:

- A simple stolen bank note, ignore the case.
- More than one stolen banknotes, check the depositors history for reoccurrences.
- A whole bunch of stolen money, try to arrest the man with bank security personnel.
- A number of strange stolen money denote a very dangerous person, do not act since police has been notified automatically and is on the way to the bank.

A simple web interface with possible stolen banknotes could disseminate deceptive information to money changers. This is possible by partially publishing the banknote serial number, for example if the BGPS authority omits one or two numbers.

C. Taxes ratification

“Black money” as an income from illegal activities, that is not reported to the government for tax purposes. In several European countries black economy reaches enormous percentage up to 50%. Such a number reduces the development capabilities of the country and even endangers the development of our common European future. Greek taxes agency fighting against VAT and taxes economic crime does not permit payments in cash or outside the banking system above the amount of 15000 Euros. Recently they study minimizing that limit to 1000 € but there are bureaucracy drawbacks.

In order to retain every payment into the banking system BGPS is a fine solution. The procedure is slightly different:

- Every banknote deposited to a bank is characterized as “taxes correct” with a minor database expansion.
- This banknote is recognized by the taxes agency representing a legal accounting transaction.
- Taxes Agency recognizes only taxes correct money.
- No rejection, warning or other action is needed. It is enough the threat of a possible future investigation.

D. Money laundry

In our times there are two major worldwide war scenes the terrorist war and financial crisis. In this war one of the major weapons is money laundry. With BGPS armed banks and ATMs we forefront thousands of battalions into the enemy lines. Every single banknote is traceable, recognized, registered and retained for the eternity. In such a dimension United Nations is entitled to fight such a war.

Of course organized Nations follow up the organized crime with significant delay and they cannot win such a war. GBPS money can only:

- Increase the cost of money laundry.
- Reduce the speed of money availability to the crime.
- Increase the danger of legal pursuit and therefore the total operation costs.

- Seed uncertainty into terrorist and mafia payments.

E. Monetary modeling

Until today monetary figures like money circulation velocity and total amount of money was stochastic variables limited to electronic money transfer more close to macro economy. GBPS facilitates the monetary modeling by examined all details of actual economy operations.

According to the Fischer’s equation of transactions, the value of total sales (P*Q) is equal to the value of total income (M*V), that is to say is in effect the relation MV=PQ. As consequence, the increase of money circulation speed is a factor, which affects the tendency of general level increase of prices. More specifically, if the speed by which the money changes hands between the individuals for their transactions is increased, then the possibility of individuals to consume products is also increased. The increase of the possibility of individuals to consuming products leads to increase of total demand of economy and of general level of prices. In the case certain where the increase of circulation of money is accompanied by simultaneous increase of production it is possible we are not led to increase of general level of prices.

[13, 15]

All these definitions are stochastic thoughts of older economists in their effort to explain the economic environment. With BGPS their stochastic approach is evolved into real time globalized money data. Therefore we attempt today a more accurate redefinition of money velocity more close to traditional definition of meters per sec (m/sec).

Money circulation velocity primary units are:

- €/sec=exact amount changing hands per second.
- m/sec= exact number of meters that a certain Euro bill covers in seconds.
- €/sec/sec= acceleration of money circulation, more understandable as amount per hour per month.
- m/sec/sec= money acceleration.

Variations here are fiveEURObil per second and fiveEURObill meters per second. All these for all Euro banknotes.

This preliminary redefinition is attempted just to demonstrate the capabilities of GBPS. We started research to support this pre-assumptions in the economic environment.

IV. PRE ALPHA TEST – CONCLUSION

In our initial pre alpha test we faced a number of technical problems. Few of these were crucial for our inability to attract a serious bank or ATM industrial partner while the rest were above our capabilities to deal with. Problem summary is:

- Actual money availability: How many 500 € bill a regional University team could borrow for a few days?
- Actual ATM machine: Until now manufacturers and their local representatives do not pay attention in our design.
- Creditability: Our University has not the structure to deal with a confidential development.
• Development cost: All software and hardware parts have huge high cost. Apart from these real life troubles our research will focus in the future must cover more serious aspects:

• Illegality: our system faces serious legal hitches like the rights for private life, procedural drawbacks, etc.
• Cost: even if the GBPS machine cost is affordable the actual overall cost could climb up huge amount.
• Conservative banker: Bankers and Central Banker are persons very difficult to deal with them.
• Marketing item: A simple solution could be a bank to establish our system and promote it as marketing item that cancels any everyday crime scenes.

V. REFERENCES

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