Czech University of Life Sciences Prague

Faculty of Economics and Management

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Bachelor Thesis

Blockchain in e-government: Case of Bangladesh

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CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

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BACHELOR THESIS ASSIGNMENT

Mohammad Badrul Alam Rasel

Informatics

Thesis title

Blockchain in e-government: case of Bangladesh

Objectives of thesis

The main objective of the thesis is to investigate the use of blockchain technology for improvement of e-government in Bangladesh.
The partial goals of the thesis are such as following:
- To make a current literature review of blockchain technology in government sector with a special focus to southern Asia.
- To propose and design a prototype solution based on blockchain for vehicle registration in Bangladesh.
- To evaluate the proposed solution and conclude outcome of the research and how it will improve government in a overly populated country Bangladesh.

Methodology

The methodology of the thesis will be carried out by investigating already implemented blockchain technology around the world. Later on a case study will be performed on the existing government processes in Bangladesh, in this case, vehicle registration and own research will be performed. When the relevant data will be collected and analyzed, a prototype to transform the existing process into a smart database using blockchain will be made and tested. Further, methods such as comparison, deduction and induction will be employed in the research. Finally, by synthesising the results of the practical part and the outcomes of the literature review, final conclusion and recommendations will be formulated.

The proposed extent of the thesis

30 – 40 pages

Keywords

Blockchain tehcnology, Ledger, e-government, Decentralized database, Trusted advanced computing, Distributed computing

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Recommended information sources

Bitfury: Blockchain for Government. Corsi, Elena; Weiss, Mitchell. Harvard Business School Cases. Oct 01, 2017

Blockchain in government : Benefits and implications of distributed ledger technology for information sharing. Ølnes, Svein; Ubacht, Jolien; Janssen, Marijn. Government Information Quarterly. Sep2017, Vol. 34 Issue 3, p355-364. 10p. DOI: 10.1016 / j.giq.2017.09.007

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Prague on 11. 03. 2019

Declaration

I declare that I have worked on my bachelor thesis titled " Blockchain in e-government: case of Bangladesh" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 15/03/2019 _____

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I would like to thank my supervisor Professor Ing. Milos Ulman Ph.D

Blockchain in e-government: case of Bangladesh

Abstract

The bachelor thesis describes the possibility of blockchain implementation in the vehicle registration system of Bangladesh. Current vehicle registration system is prone to corruption, bureaucracy, lagging of processes and the thesis proposes a new system to tackle these issues. Theoretical part of the thesis evaluates the current state of E-government in general in Bangladesh and other South Asian countries. It also provides overview of blockchain in general and shows how blockchain has been already implemented in different countries in government sectors. The practical part analyses the current vehicle registration process with use case and proposes a new system with blockchain capability to replace the current system. Practical part also provides requirement analysis and SWOT analysis of the new system and shows a prototype of mobile application to show the ease of use.

Keywords: Blockchain, Information system, E-government, Vehicle Registration, Bangladesh, Software implementation,

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2 Introduction

One of the major struggles for the citizens of developing countries is to have proper access to governmental services. The country talked about in this paper is no exception. Bangladesh is one of the densely populated countries in the world. That means providing world class services in various sectors is a tough job for any authority. Let it be banks, health care or vehicle registration. In the era of data and technology, government of Bangladesh have taken extraordinary steps to make the country "digital" by 2021 (Prime Minister's Office, 2010). There just might be a way to fully digitalize this small country, blockchain.

Blockchain is word that has been heavily talked about all over the internet in the past couple of years. There has also been scepticism about whether or not this technology is the answer to most of our digital problems (Anderson, 31 October 2018). But recent strives of public and private sectors embracing the beauty of blockchain has really paved the way for smaller and less-wealthy countries to tackle some of the issue within the public services.

Blockchain technology can come in handy in the vehicle registration process in Bangladesh. Right now, in no services in the public sector blockchain is implemented. It can reduce the time needed for the vehicle registration, terminate corruption in government sector, increase transparency, more reliability between the personnel involved, and set as a role model if used effectively, to adapt blockchain in the other public and private sectors.

If blockchain is implemented properly, vehicle registration process would take only seconds. The data for the vehicle, owner and other parties involved would already be in the secure database which has been stored using distributed ledger technology (Wattenhofer, 2016) that reduces the chance of tampering the data to 0 %. In this process no third party would be needed to verify any of the information. The data or information about the vehicle and owner and the history of the transaction of the car for a leasing company would be available to the relevant companies and Bangladesh road and transport authority. When an owner or a leaser requests for vehicle registration, the relevant authority can verify the person, history and make of the car, insurance, driving license, any other

necessary info, all in one database/platform and issue the registration immediately upon the payment of fee needed for registration process. This system will also notify user through a secure application that the vehicle registration is complete and provide the registration number, so the owner can print the number plate.

The system would potentially save millions of dollars, time, increase trust in the government system. This is the era of modern technology and it's time for developing countries like Bangladesh to adapt this kind of technologies. The government of Bangladesh has the vision of Digital Bangladesh 2021 (Bangladesh, 2014), which dates the 50 years of independence and the government can take couple of steps forward to make the country truly digital.

3 Objectives and Methodology

3.1 Objectives

The main objective of the thesis is to investigate the use of blockchain technology for improvement of e-government in Bangladesh. The partial goals of the thesis include to make a current literature review of blockchain technology in government sector with a special focus to southern Asia. Then to propose and design a prototype solution based on blockchain for vehicle registration in Bangladesh and proof of existing blockchain implementation. Followed by the evaluation of the proposed solution and conclusion of outcome of the research and how it will improve government in an overly populated country Bangladesh.

This thesis will show how blockchain in vehicle registration can be used as a role model to be implemented in the other public sectors of Bangladesh. Part of thesis will also describe the current process and figure the real impacts of the technology in various levels of the government.

The thesis will also focus barriers around the implementation of blockchain and emphasize on the impact of it in the society

3.2 Methodology

The methodology of the thesis will be carried out by investigating already implemented blockchain technology around the world. Later on, a case study will be performed on the existing government processes in Bangladesh, in this case, vehicle registration and own research will be performed. When the relevant data will be collected and analysed, a prototype to transform the existing process into a smart database using blockchain will be made and tested.

The thesis will also focus on the pros and cons of the technology and the barriers around the implementation of blockchain and emphasize on the impact of it in the society

Further, methods such as comparison, deduction and induction will be employed in the research. Finally, by synthesising the results of the practical part and the outcomes of the literature review, conclusion and recommendations will be formulated.

4 Literature Review

To use and implement blockchain in any sector properly, we need to understand blockchain first. Since it is a relatively modern technology, most people are not very aware of it. To a big percentage of people who have knowledge about blockchain can only refer to cryptocurrencies. Since not all understand the concept of cryptocurrency or think it's a fuzz to invest money, they disregard blockchain too. On the contrary, blockchain has many more advantages and implemented correctly everywhere can change the course of the world, make our lives easier and effortless. And the way technology is improving there is no way other than embracing blockchain in and replace the current services to make a better future.

In this literature review the author will explain in simple words what a blockchain is, how it works and the use of blockchain in different sectors.

4.1 Blockchain

In simple words blockchain is a distributed, decentralized and public ledger. Transactions are recorded in many computers, so records cannot be altered. Blockchain uses a data structure that creates a digital ledger and shared by many individuals and network.

Blockchain can be broken down into three different sections (Laurence, 2017)in order to make it understand easily.

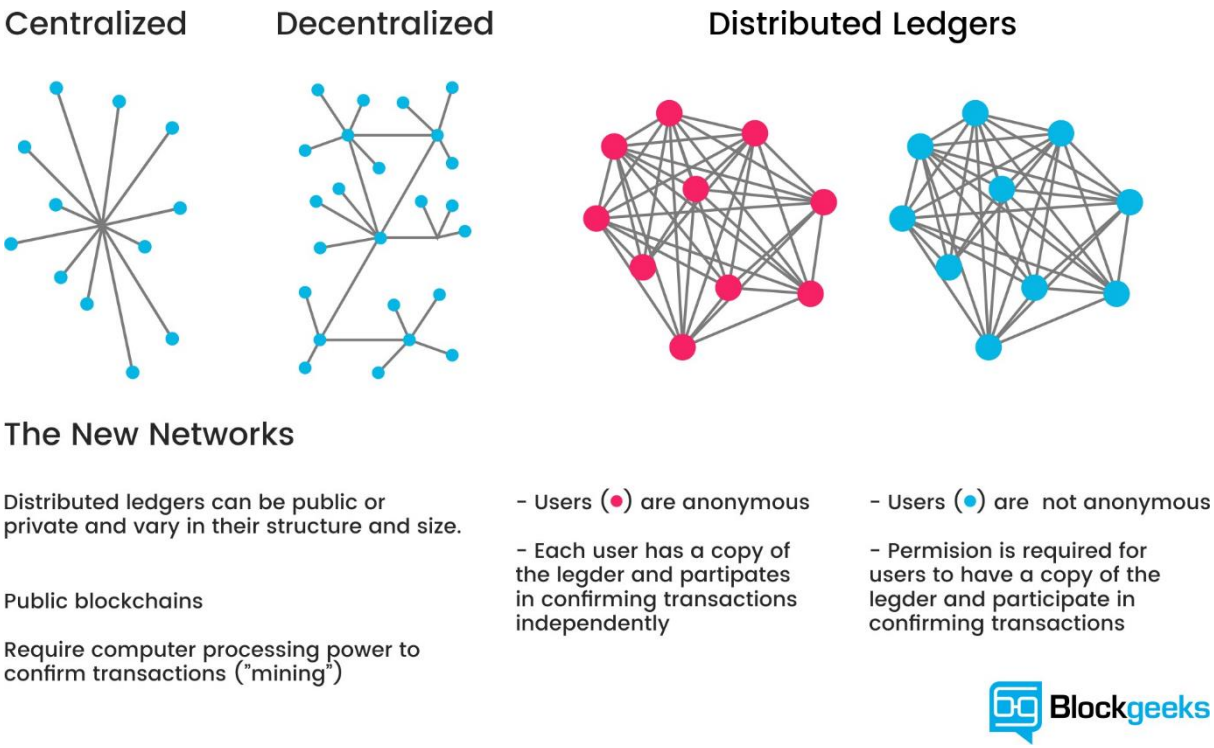
Block: It is a selection of logs or history for a given period. For instance, in cryptocurrency each block stores all the transaction ever made for the particular coin. The job of block is to record all the transaction or movement.

Chain: It is the connection between different blocks. It somehow works like Legos. If we think each block as Lego pieces and the connection between that would be a chain. This is how each block "talks" to another and share the data.

This chain uses the well know method hashing (Konheim, 2017). Hashing is a very effective way to provide security to a program. In this process, each string generates a value using a mathematical function.

When a message is conveyed using this method, each string is encrypted into some code. When the receiver tries to decrypt the message it creates another hash, and in the two hashes match then the message gets decrypted creating a secure connection.

Network: The network part consists of nodes. Each node has the same information and distributed all over the network as identical copies. With this method each end user has the exact copy of the information. So, if any unauthorized person tries to alter the information, they must alter all the nodes at the same time. For this reason, blockchain is almost impossible to be altered or hacked.



1Blockchain Ledger

(Blockgeeks, 2019)

The most common use of blockchain is the cryptocurrency market. Where to trade coins between users, they don't need some third-party personnel to verify transaction since everyone has the same block and the nodes make it impossible to tamper with.

For the last couple of years, hype about blockchain is at its peak and various companies from different fields are planning to adapt blockchain such as in supply chain, music rights, health care.

The underlining assumption is that blockchain is a magical device that will keep the data safe and secure for any organization. But on the contrary, it is hard to implement it and maintain and there are various reasons for that.

Creating a system that will work smoothly for lifetime is not easy. Maintenance cost is very much and chances of being affected by bugs are also evident. A small virus can mess the entire database of make the data differ and the database will lose its value. If the database is "broken", the database will lose consistency and be worthless.

It is also very important to make sure the database contains useful data. Even if the cost of putting data into the database is very low, its important the database doesn't containing useless data. In such case blockchain would be consistent but not very useful.

Moreover, A traditional centralized database only needs to be written to once. A blockchain needs to be written to thousands of times (Song, 2018). A traditional centralized database needs to only checks the data once. A blockchain needs to check the data thousands of times. A traditional centralized database needs to transmit the data for storage only once. A blockchain needs to transmit the data thousands of times.

One other issue in decentralized database would be users are independent and sovereign. So, if any user has any sort of intention to affect the database in a negative, kicking out the user would not be that easy. Like in centralized database, it's a lot easier to refuse services to a malicious user but in decentralized database no Sigle entity has the authority to keep another user out. SO, the blockchain needs to be impartial and laws should be strictly defined by the software.

Like a centralized system, blockchain cannot be forcefully update or upgrade anytime one entity wants, because one single entity does not possess the power to do so. For that, consent of all the other users is absolute necessary or else it would just behave like a centralized system. The main point of blockchain is to now give away any power to an individual or a group to temper with the data.

Even though from the points noted above we can see implementation of blockchain is hard and costly, it's absolutely necessary to introduce blockchain in these day and age. Some industries are running their software on very old system and its necessary they move into a newer system and blockchain comes in handy for them. Most of the healthcare companies are running terrible software and same goes for financial settlements. Industries like supply chain and procurement need to adapt to blockchain because of the risks involved with a centralized database system.

Also, people like to have power to themselves and an example can be government interference in different independent sectors. Or the overwhelming reign of bigger industries and how they can keep everyone under the umbrella of very little knowledge. For that reason, the people who have certain know of blockchain wants speedy implementation blockchain thinking that would add to their freedom.

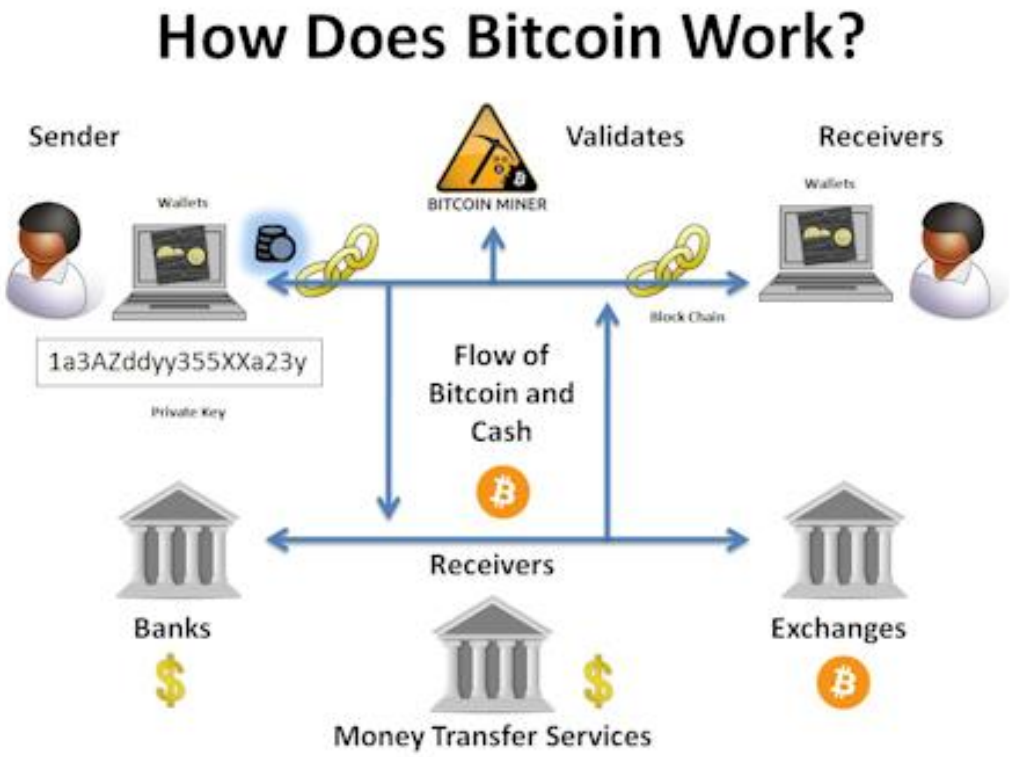
Nevertheless, blockchain as already earned its name in the last decade and proving worthy of keeping the world a much safer cyber place. As we have seen rapid growth in cloud technology and advancement in artificial intelligence, blockchain will have its toll in the cyber market pretty soon.

4.1.1 **Blockchain in Bitcoin:**

In order to fully understand blockchain we can look at cryptocurrency. We can say cryptocurrency is a successful implementation of blockchain technology. The cryptocurrency that was introduced first and still tops the market capital is Bitcoin (Cap,

2018). It is still unknown who really created bitcoin, but some believe its Satoshi Nakamoto (Economist, 2015).

The system enables payments to be sent between users without passing through a central authority, such as a bank or payment gateway. A transaction is a transfer of value between Bitcoin wallets that gets included in the blockchain. Bitcoin wallets keep a secret piece of data called a private key or seed, which is used to sign transactions, providing a mathematical proof that they have come from the owner of the wallet (Bitcoin.org, 2018).



2Bitcoin Process

(SteemIT, 2019)

But unlike any other currency the supply is controlled by and algorithm and a maximum number of 21 million bitcoins can be mined, this makes bitcoin a very attractive asset (Coindesk, 2018).

With this system the transaction cannot be tampered since it is using the blockchain technology and in order for someone to hack or tamper the data they have to change the

transaction history for every single ledger at the same time which is almost impossible, and it made bitcoin a big hit and secured.

4.1.2 **Proof of Work vs Proof of Stake**

The founder of bitcoin used proof of work protocol to deter cyber-attacks like DDoS attacks which has the purpose of messing up the resources of the database by sending multiple fake requests. This concept was existing even before bitcoin, but the founder of bitcoin used it to revolutionize how digital transaction works. Proof of work introduced trust less and distributed consensus.

That means if somebody wants to send money he/she doesn't have to rely on a third part service to verify the transaction. People have been using traditional payment methods online such as Mastercard, Visa, PayPal who has their own private register and verify and store each transaction. In this process both the sender and the receiver have to rely on the third party to do the right needful thing. What bitcoin introduced is that everyone has a copy of the same thing called a ledger and nobody has to consult a third party, they can verify each transaction themselves.

There is another term that is heavily used called mining in digital transaction. Mining is used to create a new group of transaction on a distributed ledger. Mining essentially serves two purposed, verifying the legitimacy of the transaction and creating a new group of transaction. Transactions are grouped together calling them a block and miners verify that each block is legitimate. And that's where proof of work comes in. In order to verify the legitimacy of the blocks, miners have to solve mathematical puzzle called proof of work. And because miners are physically working on the verification process each miner who solves the problems are given rewards and verified transactions are stored in each blockchain.

When a miner finally finds the right solution, he/she announces it to the whole network at the same time, receiving a cryptocurrency prize (the reward) provided by the protocol. From a technical point of view, mining process is an operation of inverse hashing: it

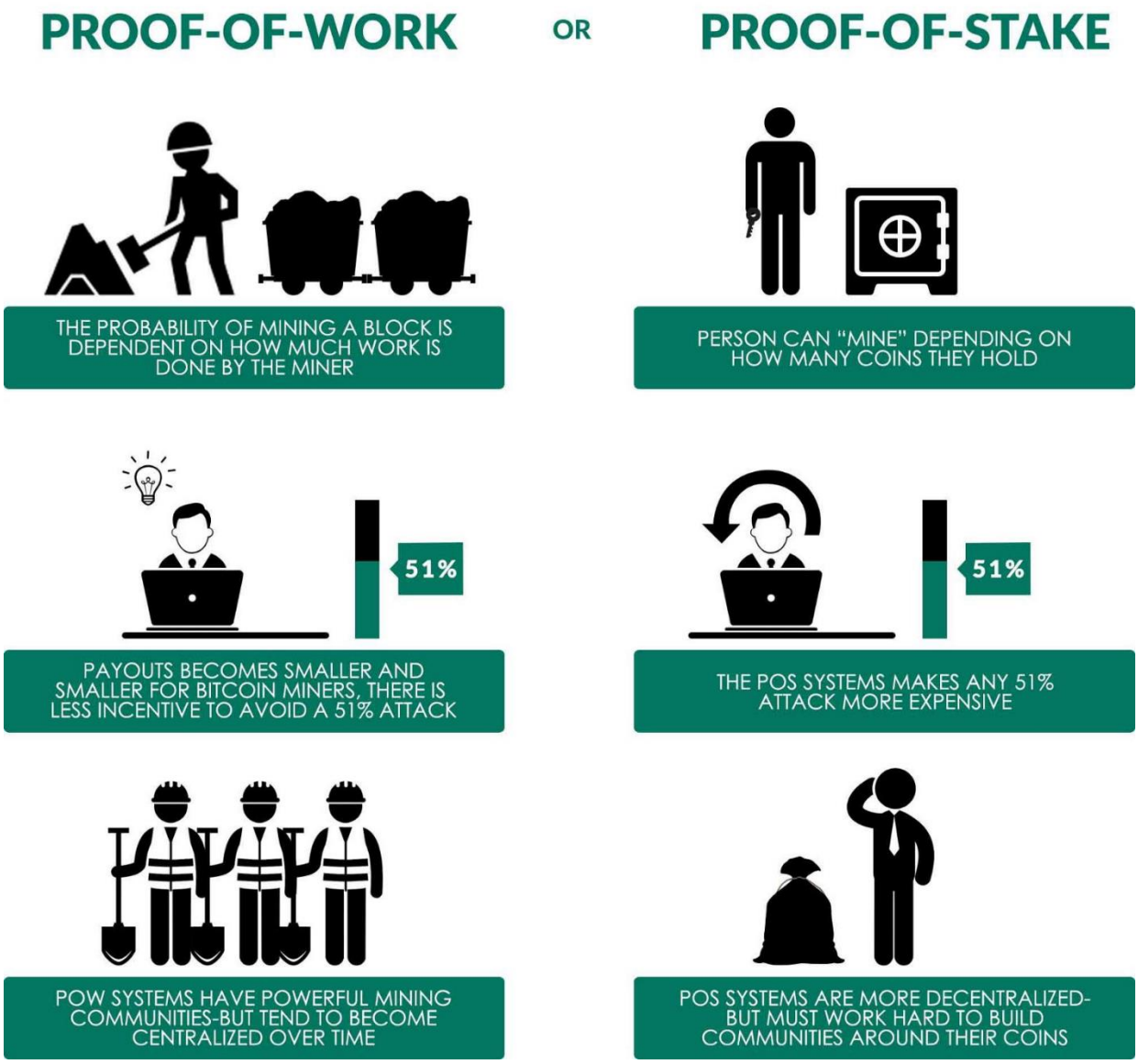
determines a number (nonce), so the cryptographic hash algorithm of block data results in less than a given threshold. (Blockgeeks, 2019)

Proof of work is not only used by the bitcoin blockchain but also by Ethereum and many other blockchains. But now Ethereum developers wants to change proof of work protocol into proof of stake.

Ethereum is an open source and blockchain based distributed computing platform it supports modified version of bitcoin's consensus transaction-based state transitions. (CoinDesk., 2016)

Developers have shifted themselves to use proof of stake to achieve distributed consensus for Ethereum. Unlike the proof of Work, where the algorithm rewards miners who solve mathematical problems with the goal of validating transactions and creating new blocks, with the proof of stake, the creator of a new block is chosen in a deterministic way, depending on its wealth, also defined as stake. No one is rewarded for a block so miners take the transaction fees and miners are called forgers.

The main reason to use proof of stake was saving electricity. To use proof of work miners use a lot of energy and this energy cost is paid by typical currency to the relevant authority which is contradictory to the idea of digital currency. Developers are pretty worried about this problem, and the Ethereum community wants to exploit the proof of stake method for a more greener and cheaper distributed form of consensus.



3POW vs POS

(Hackernoon, 2019)

Now, if the technology and reduce third party for transaction between people, this can surely be implemented in different sectors of the government.

4.2 E-governance and E-services

E-government simply refers to use of new technologies for seamless communication between different entities (Richard Heeks, 2001). This digital interaction can be between government to other government agencies (G2G), Government to citizens (G2C),

government to employees (G2E) or government to business organizations (G2B). The main goal for e-government is to reach out to every sector within the country and pass along information with minimal cost, short time and effectively. Using modern technology, government can replace human-executed processes with automation, can make better decisions, deliver better services and ultimately form better trust among the citizens. Having access to government services is a fundamental human right and every country has focused on that. To reach the maximum level of effectiveness, every government has free or low-cost e-services available to its public (Richard Heeks, 2001). E-service basically means transforming already existing public services into digital service so that the people can use the service over telecommunication platform or over the internet.

E-service is not a new system. In fact, since the dawn of the internet almost every country has digitalised public services. Example of such is to apply for a university online or paying the utility bill over the internet. Most countries have also focused on transforming more complex process fully digital such as filing for tax or online registration of a new born child. Today, thousands of services are available to use for the global citizens, and companies.

One of the keys to achieve e-government is to build a firm and robust IT infrastructure. One way to measure the strength of IT infrastructure is to measure the average internet speed of the country. And whenever we have seen a country with better internet facilities, ranks top in the e-services development index (Nations, Regiuonal Data, n.d.)

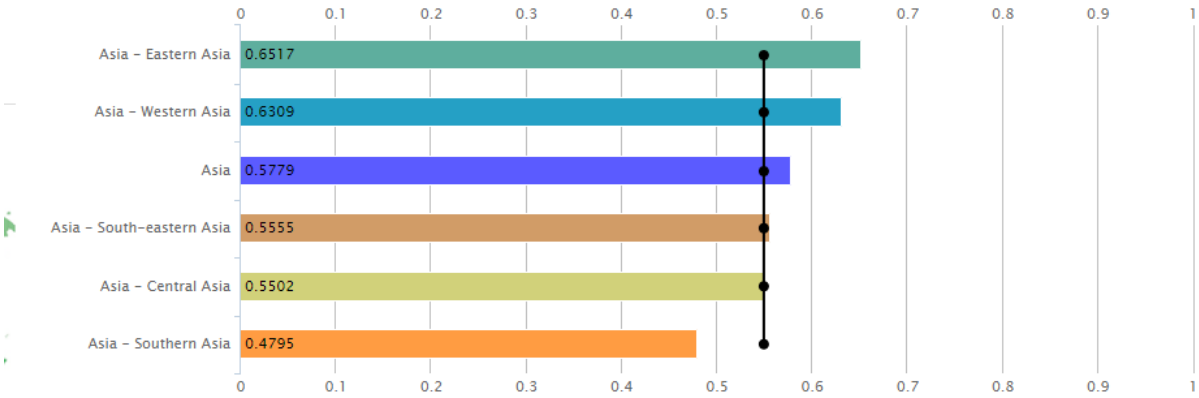
As stated above blockchain is very innovative and effective way to store and share data. For this reason, many private companies and government started to implement blockchain in their database to secure their information.

4.3 **E-government in South Asia**

Use of e-governance can make public administration fast and effective, provide better services, and respond to the demands of transparency and accountability. It can help the

government to go green by effective management of natural resources aiding sustainability to environment.

Development of e-government has been quite steady for south Asia region. Even now, according to the latest data from United Nations, Southern Asia ranks the bottom of the list among all sub-regions of Asia.



4Asian EDGI Index

(nations, 2019)

As shown in the data above, only south Asia has lower score than the global average which is 0.5491 (Nations, Regiuonal Data, n.d.). Taking a deeper look among the south Asian countries, Sri-Lanka shows the highest score 0.5751 followed by 0.5669 and the bottom of the list is Afghanistan with just 0.02585.

Mathematically, the EGDI is a weighted average of three normalised scores on three important dimensions (or components). They are: online service component, telecommunication infrastructure component and human capital component. The index for each of them indicates in itself a composite measure which is accounted independently.

From this data it's clear that South Asian countries lack significant amount of development in all three components of EDGI. But looking at the e-participation index India is the second with a whopping 0.9551 score. That can only mean the government is much keen to provide information about ICT to the public and trying to engage the people into public

policies and services. But the high score can also reflect the massive population of the region.

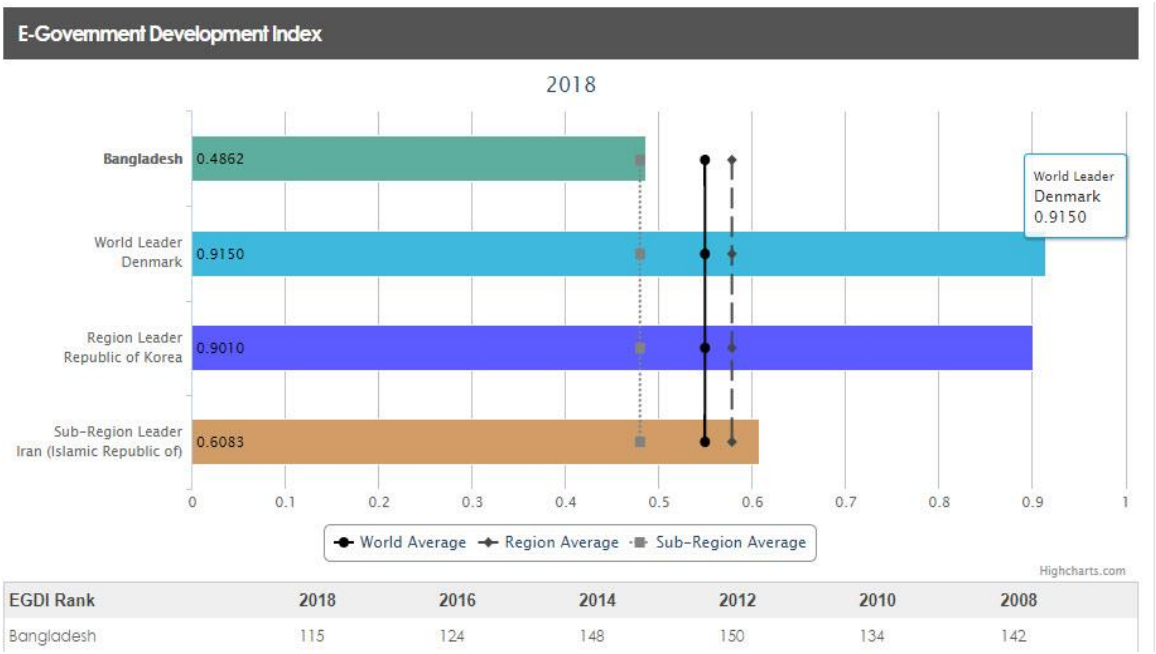
On a macro all the countries in South Asia provide similar type of e-services. To name few would be vital registration, social assistance, marital status change, utility bills, application for university admission. The services can be integrated for fully automatic transaction of relevant fees or in most cases filling out the form and paying the fees at the bank.

4.4 E-government and EGDI Index of Bangladesh

E-government Development Index (EGDI) of United Nations (UN) is a composite indicator or measure of the capacity of a government to use ICT for delivery of services to the citizens. EGDI is useful for government officials, researchers, policy makers, civil society and the private sectors etc. to gain deeper understanding of relative position of a country for delivery of inclusive and accountable services to the citizens in general.

UN publishes EGDI index every two years, which provides a snapshot with relative rankings of developments of e-government of the member countries. The survey provides relevant information for the policy makers and government departments in shaping e-government programs for development activities. EGDI is based on assessment of online presence by assessing the national websites and e-government policies and strategies for delivery of government services. The assessments rate the performance in e-government of countries relative to one another and not in an absolute basis.

Bangladesh ranks 115th on the global rank in the E-government development index. (Nations, 2018). In 2016, Bangladesh ranked 148th and in 2014, 150th.



EGDI Rank	2018	2016	2014	2012	2010	2008
Bangladesh	115	124	148	150	134	142

5EGDI Bangladesh

(Nations, 2019)

Bangladesh's point on EGDI on 2018 is 0.4862 while the global average score is 0.5491. With all the advancement in the digital sector and steps taken by the government one can easily hope Bangladesh will surpass the average EGDI score in 2020.

As a result, the government of Bangladesh has taken a few initiatives to add e-governance to different sectors of the country. The slogan of "Digital Bangladesh" of the Government of Bangladesh has special significance for e-governance for national development. Despite all the limitations the government is still focused on fulfilling the promise they made to its people with Vision 2021. Many e-government projects have already been completed and a considerable number of projects are under progress.

Popular examples of available e-services are: registration for admission to academic institutions, publication of results of examinations, registration for jobs abroad, registration for pilgrimage, delivery of official forms, online submission of tax returns, online tendering, online banking and many more. SMS services for lodging complaints to police stations, online bill payments for utility services, instant communication with persons working abroad, and e-passports are examples of more e-services.

Telemedicine services, videoconferencing for the treatment of diseases (Ahasanun Nessa, 2008), and video conferencing for administrative activities are special examples of e-services available for rural Bangladesh.

The expansion of technology can be seen in many sectors in Bangladesh these days. The most prominent would be developing the ICT sector. A new database let it be distributed or centralized needs a very strong telecommunication sector. Or even the most secure system would lose its efficiency if there no proper infrastructure to support it.

In order to implement blockchain in any sector in Bangladesh it is absolutely essential that Bangladesh possess a better score on the EGDI. All the technology that would be involved in the process of implementing blockchain requires very strong telecommunication background.
Each modern technology requires new skills and new people with training and ICT based education is now a mandatory.

4.5 Successful blockchain adoption and implementations

In the recent years, distributed ledger technology has caught the eyes of different private and public organizations and led to adaption of blockchain in various sectors.

One of the major implementations of blockchain technology is MedRec where electronic health records (EHRs) have been used in a very smart way. EHR was not designed to be used in a multi-institutional platform as patients can get healthcare from different companies for different medical facilities. It is also very much possible for patients to lose electronic health record data if they are scattered in different institutions.

MedRec is a decentralized record management system for EHRs. The system provides a complete log and access to every health events and medical information across providers and medical sites (MIT Media Lab, August 2016).

By using blockchain technology MedRec provides confidentiality, accountability, authentication for the patients. MedRec incentivizes medical stakeholders (researchers,

public health authorities, etc.) to be part of the network as miners. In this way the researches have access to analysed, trusted, up-to-date data as mining rewards in return of securing the network by proof of work (MIT Media Lab, August 2016). This way MedRec provides the researches big data for their user and also a secure database for the patients. In MedRec the data the block contains data ownership and viewership permitted by the members of the network.

In this system using blockchain technology MedRec potentially uses “Smart Contracts” allows system to track the transaction of inclusion of a new record. The system contains blockchain cryptographic hash of the record to prevent tampering of the data thus providing data integrity. When providers record a new data for the patient, the patient can authorize the records between providers. When new data is recorded it gives notifications to receiving party before accepting the data and it keeps all parties involved in the process (MIT Media Lab, August 2016).

In order for understanding such implementation fully, understanding of smart contract is also important. Smart contract is self-executing scripts that reside on the blockchain– integrate these concepts and allow for proper, distributed, heavily automated workflows. Nick Szabo introduced this concept in 1994 and defined a smart contract as “a computerized transaction protocol that executes the terms of a contract” (KONSTANTINOS CHRISTIDIS, 2016).

A smart contract is a program that runs on the blockchain and has its correct execution enforced by the consensus protocol. A contract can encode any set of rules represented in its programming language—for instance, a contract can execute transfers when certain events happen (e.g. payment of security deposits in an escrow system). Accordingly, smart contracts can implement a wide range of applications, including financial instruments (e.g., sub-currencies, financial derivatives, savings wallets, wills) and self-enforcing or autonomous governance applications. (Singapore,

2016)

Source: Deloitte University Press, DUPress.com

6Smart Contracts

(Finance, 2019)

Bitcoin company BitFury and the government of Georgia have come together to develop a system that would register lands with distributed ledger technology for its people (Kshetri, 2017). Normally as like other countries, citizens need to go to public registry for any transaction related to land buy and sell. They need to pay a fee ranging from 50-200 euros for that and it generally takes long time. The system is supposed to be replaced by blockchain paving the way to complete the whole process between 0.05-0.10 euros or almost nothing. The technicality, cost and general availability are yet to be published.

Another prominent leader of IT industry, Estonia, has been the pioneer of adapting modern technologies in its public sector. From 2014, they have been issuing e-ID cards for the people (Clare Sullivan, 2017) and the first country to announce the concept of E-residency. That means anyone can be a “citizen” of the country without even staying in Estonia through government backed identity credential E-residency platform. That means use of government services, transact with any authority with digital trust service. The government has further signed a treaty with Bination ("voluntary nation" that records vital records, identity and other legal events using blockchain technology.) in 2015 to develop a public notary service to Estonian e-Residents.

Countries from the continent Africa, like Ghana, Zimbabwe, Uganda, Sierra Leone, Rwanda have been using bitcoin for money transaction using Bitsoko. Mexico has been using a service called mexBT that utilizes blockchain for cross-border payments among companies in emerging economies (Kshetri, 2017).

With these big strides, one can predict more and more countries will take their first steps to adapt blockchain in the very foreseeable future.

Recently the Estonian government has implemented several governmental services under blockchain. For example, they have implemented blockchain technology to store public health record for entire population (Laurence, 2017). This away both the patents and the health profession have access to vital information to ensure maximum health care service and 100% transparency.

As an illustration of blockchain potential, the UK's Government Office for Science have proposed several use cases for blockchain technology that point to using the technology for

(1) protecting critical infrastructure,
(2) novel payment systems for work and pensions,
(3) strengthening international aid systems,
(4) document authentication and smart contracts, and
(5) handling European VAT.

Of these suggested application areas, the authentication of documents (CVs and other certificates, licenses, intellectual properties and patents, wills etc.) is the most interesting in terms of short–term realization. Thus, using blockchain technology for land title registry is an interesting use case for the public sector, highlighting the use of blockchain technology for secure storage of authentic documents as part of the effort to innovate e-Government solutions. (Science, 2016)
Dubai future foundation has announced that they would establish Global blockchain council to keep up with the latest technologies and practices. (Government, n.d.)

Switzerland has The Crypto Valley Association which is a government-supported organization established to take full advantage of Switzerland's strengths to build the world's leading blockchain and cryptographic technologies ecosystem. They are encouraging start-ups and established enterprises through policy recommendations, projects across verticals, initiating and enabling research, and organizing conferences, hackathons, and other industry events.

Since blockchain is still a very new concept, it might take some time for other countries to follow through and adopt it. Here in this article the author, will explain how the government of Bangladesh can implement blockchain in one sector and make it as a role model.

5 Practical Part

5.1 Current Vehicle registration process in Bangladesh

Bangladesh is one of the densely populated country in the world. The population of the city Dhaka is almost 19 million (BBS, 2013). Due to the growing number of populations, everyday hundreds of vehicles are registered daily by Bangladesh Road and Transport authority. Below stats show the number of registered vehicles in the country till 2016.

Type of Vehicles	Upto-2010	2011	2012	2013	2014	2015	2016	Grand total
Motorcycle	210081	34708	32810	26331	32894	46764	52738	436326
Private Passenger Car	163004	11423	8187	9231	12972	18422	18010	241249
Microbus	46202	3540	2643	2227	3842	4569	5169	68192
Pickup (Double/Single Cabin)	20481	7258	5149	4908	7295	7916	8482	61489
Truck	26922	4205	2824	3522	5767	4424	4553	52217
Taxicab	36011	52	43	4	302	54	30	36496
Jeep(Hard/Soft)	19520	1698	1241	1107	1582	3109	4217	32474
Bus	16783	1501	1218	971	1364	2221	3479	27537
Tractor	9923	4169	2841	1634	1443	1637	2510	24157
Delivery Van	11990	839	577	709	901	1464	1898	18378
Covered Van	4277	1910	1170	1850	2532	1855	2316	15910
Minibus	9490	136	103	83	135	103	164	10214
Auto rickshaw	7664	112	111	60	56	428	582	9013
Cargo Van	3231	477	278	676	603	398	1001	6664
Others	168	0	0	660	967	1307	2567	5669
Human hauler	2718	569	145	115	109	502	787	4945
Ambulance	1374	137	114	190	254	258	287	2614
Tanker	817	152	90	136	163	146	209	1713
Auto Tempo	1662	1	1	0	0	0	0	1664
Special Purpose Vehicle	759	60	28	78	50	66	224	1265
Total	593077	72947	59573	54492	73231	95643	109223	1058186

1Vehicle Registration Data

(BRTA, 2019)

Current vehicle registration process is as follows:

Motorbike Registration: The following documents are needed for a motorbike registration-

- Import document
- Customs clearance
- Gate pass
- VAT-11 documents of both importer & dealer
- Treasury Chalan from Sonali Bank for both importer & dealer
- Cash memo
- Owner voter ID card copy

Hence after getting the full set of documents, the applicant gets the three-paged vehicle registration form from the BRTA office or their website. This form is the application form with which other documents will be attached. If they are verified at the Bangladesh Road Transport Authority office, they will give you an assessment slip (Money Deposit Slip) filling up your vehicle information mentioning with the related charges & fees.

After that applicant needs to pay the relevant fees with 15% to BRTA recommended banks. After the deposit of fees and charges applicants then submit their complete application set at the vehicle registration desk at BRTA. On submission the application, vehicle inspector inspects the documents and also the vehicle. After the inspection and the authorization of the documents by the vehicle inspector they will give the applicants the acknowledgement slip printed with the registration number & fitness, and also the tax token.

Upon getting the token, they are allowed to ride the bikes and apply for RFID number plate.

Other vehicles such as, cars have to be registered with the Bangladesh Road Transport Authority. The documents needed for the registration are –

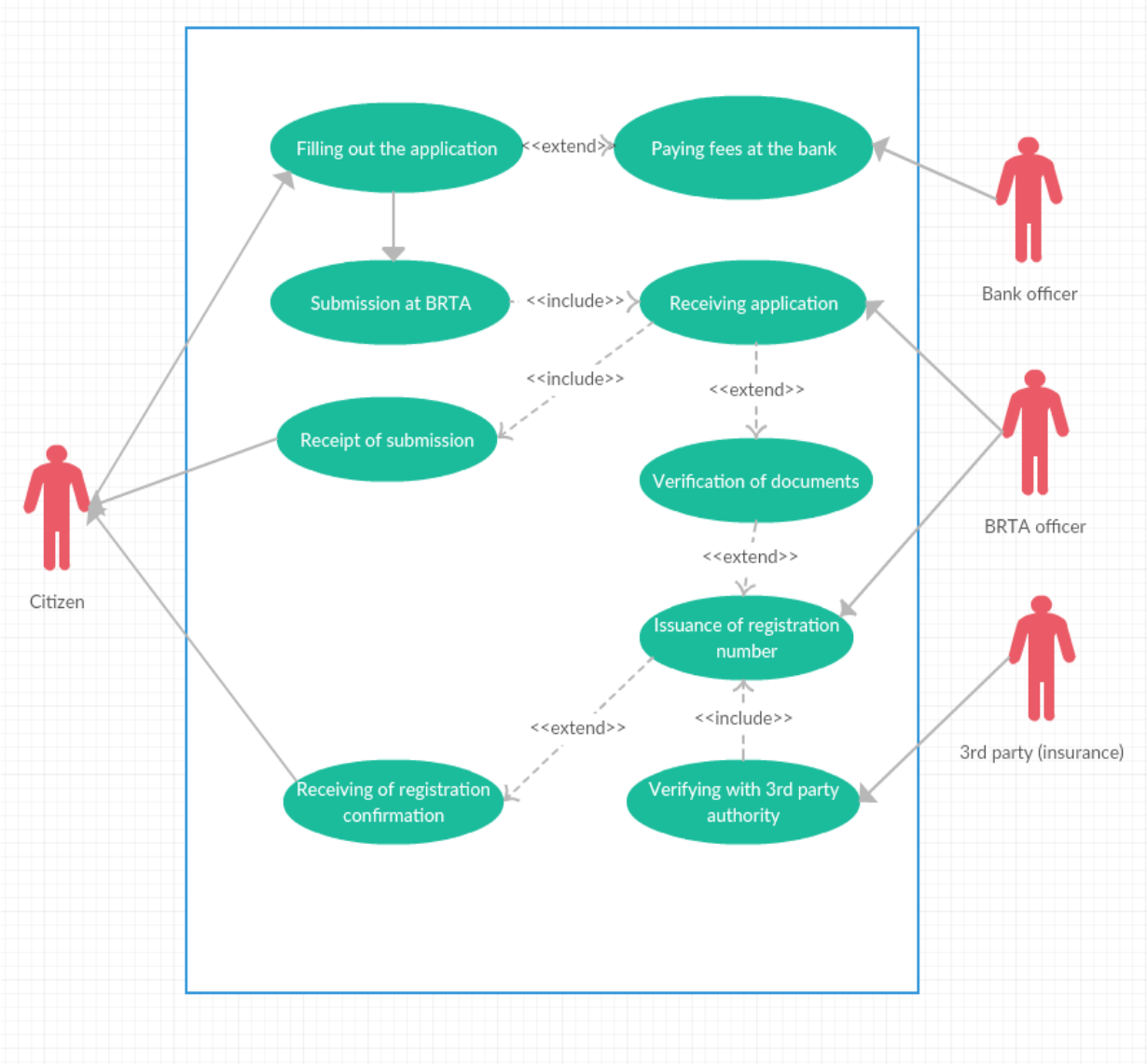
1. An application
2. Tax payer identification number certificate
3. Copy of National identification number
4. 4-8 passport sized photographs
5. Receipt of vehicle purchase
6. Insurance document

Addition to these rules, the car must be registered to the area where the owner resides. The registration can only be done in person at the local BRTA office.

Needless to say, these processes take a very long time and the application must go the BRTA office several times in this process. Main reason would be the administration has to communicate with different authorities to verify all the information about the vehicle and the applicant. Blockchain or any sophisticated database system where all the data are safe and secure would make this processes a lot easier. With distributed consensus, administration can verify the data in minutes and with the help of other e-government services can register any vehicle on the same day.

Current BRTA website provides very few information about these processes and the website needs a lot of improvements in order to correlate with a new technology as blockchain.

Use case diagram of the process is shown below –



7Use case diagram

Another big part of the registration process is bribery and corruption. In some cases, people can get their vehicle registered without going through all the processes. In this way the person who wants their vehicle registered, pays some extra money to one of the brokers who has contact within the BRTA and get their registration quicker. In this way no one

goes through proper verification. The government had intervened and had taken actions in the past to stop this corruption, but some people always find ways to do so.

5.2 Blockchain implementation overview in vehicle registration of Bangladesh

In order to implement blockchain technology in the existing system, a lot has to be done by the government as well as the citizen. Firstly, there should be a database containing information of all the citizens. Data from existing vital registration can be used for that. There should be database of all the registered cars and their transaction history containing the insurance, owner information in real time.

Once the data is collected and verified, additional registration can be started from that point. Administrator for the system can find the verified data about the owner and vehicle in a few minutes and based on that issue registration number.

Part of the system can be an application where citizens can update their information which would be easy to use. In the application users can renew their validity of the car registration, change any additional information.

Car leasing companies will also have access to this database so that during a lease they can track the history of the leaser and the car. This system can potentially save a lot of time, human resources and increase trust between both parties.

Bangladesh being a low-income country and not so resourceful needs to take these steps one at a time. Dhaka city corporation, capital and the largest city in the country can be the city to test this technology and based on the result the government can expand and include other parts of the country in a few years.

5.3 CATWOE list for blockchain implementation in Vehicle registration in Bangladesh

- Clients:
  01. Citizens of Bangladesh who will be registering the vehicles

- Actors:
  01. BRTA administrator who will be verifying the data
  02. Users/citizens
  03. Banks and Insurance companies

- Transformation:
  01. First service of its kind in Bangladesh
  02. Secure, cost effective, time saving process
  03. Getting rid of bureaucracy and fraud

- Worldview:
  01. One step closer to digital Bangladesh
  02. Open door to use blockchain in other sectors of the government

- Owner:
  01. Bangladesh Road Transport Authority

- Environment:
  01. IT infrastructure
  02. Lack of willingness to adapt new solution
  03. Bribery and corruption at various levels of government

5.4 Business side of the process

Business side of the process involves the cost of implementation and continuation of the service without any drawbacks. For a country like a Bangladesh and with current IT

infrastructure, it is going to take a toll on their annual budget. Although Bangladesh has shown good initiative for the last decade to strengthen the IT infrastructure, it has not really shown the impact of the market yet. Firstly, to run such a process, awareness among people will be the first problem and the government has to overcome that.

For implementing, a dedicated team needs to be assembled in each sector to gather up the existing data and copy to them to the new database. But looking at the impact that it will have in the future with a bit of willingness, every sector will have to be on the same page for this. The best way would be having a contract with any IT consulting company that already has experience with blockchain implementation. Government can also go through a sourcing process to select the best organization for handling the task. To save cost, logical way would be to hire citizens of the country with IT backgrounds.

First step of the implementation would be blueprinting or creating business process documentation. Further application should be configured by technical people for the process. One core part of the process is to have seamless integration between different authorities for data flow. After setting up the system, user acceptance testing has to be performed before general availability. On parallel, the end users of the system (administrators, users, employees) need to be looped into the testing process to find the optimality of the system. Moreover, engineers need to be hired both front-end and back-end to make sure the smooth operation of the new system.

Every organization involved in the process will need to train people for the new system. Employees in the BRTA, vehicle leasing companies, vehicle selling companies, people associated with health insurance for the vehicle need to be aware of such process and refrain themselves even before thinking to tamper the data. Employees of all authorities need to be trained on the new system for administration. End user support would be needed for successful use of the system.

The cost of the implementation can vary depending on the duration of the process, personnel involved and budget distribution. For Converting source code X-road and

electronic ID of Estonia, from a detailed analysis it is estimated to be 89 million euros. (Oja, 2016)

Breakdown of cost:

Creation of the document	€ 36M
Electronic certification	€11M
Issuing	€9M
Base software	€5M
User-support	€3M
Support in applications	€25M
TOTAL	€89 M

2Estonian blockchain cost for X-road and eID
(Oja, 2016)

Given that, Bangladesh has 117.6 times (Worldometers, 2019) the population of Estonia and poorer IT infrastructure the cost can go off the roof. As similar implementation has not yet happened in any south Asian country, the cost of such project cannot be estimated without detailed analysis. But recent eagerness of the government to make the country digital is a very positive sign to tackle any forthcoming issues.

5.5 Requirement analysis of the stakeholders

Requirements for the key stakeholders are given below:

Citizens:

01. Easy and hassle-free service
02. Cost and time efficiency
03. No fraud or corruption
04. Easy to understand mobile and web service for all citizens

Bangladesh Road Transport Authority:

01. Proper management of the vehicle registration process.

02. Providing top class service to the citizens

03. A platform to accommodate all the data and access the data for reporting purposes

04. Increase efficiency in the workplace

Insurance companies:

01. Easy access to records of all insured vehicles.

02. Verifying if the claim is valid of not

03. Preventing fraud in the insurance process

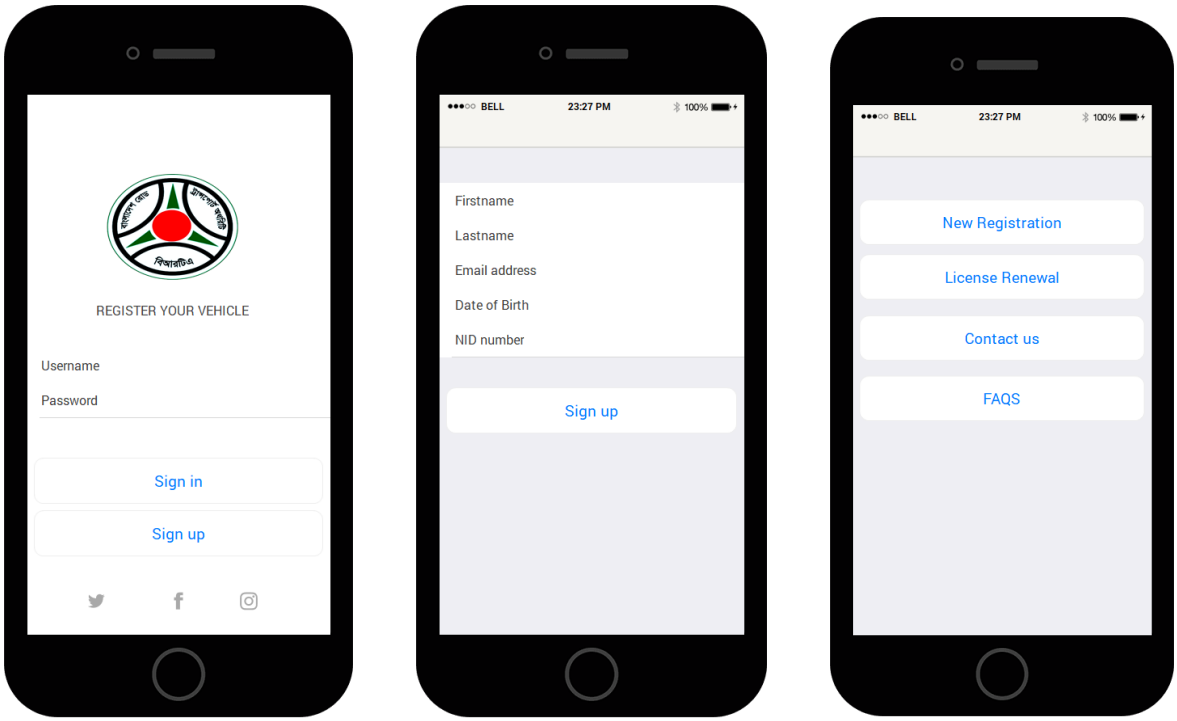
Leasing companies:

01. Verifying renter's identity easily

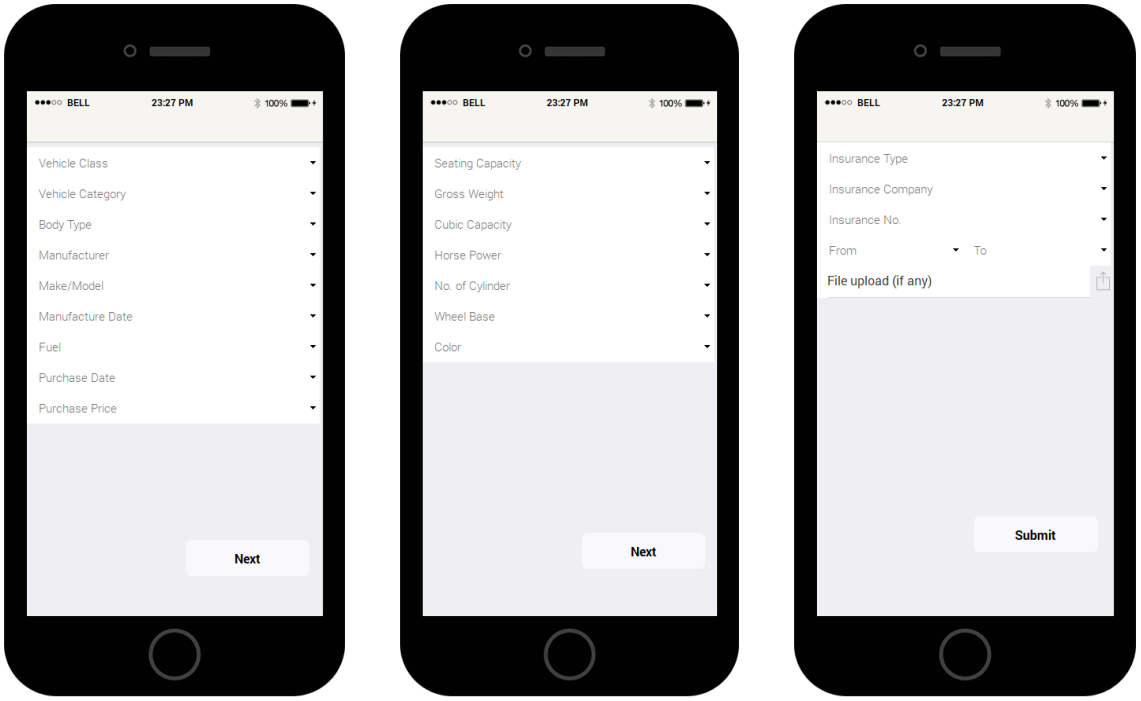
02. Seeing all the records related to previous lease

5.6 Prototype of Mobile version of the service

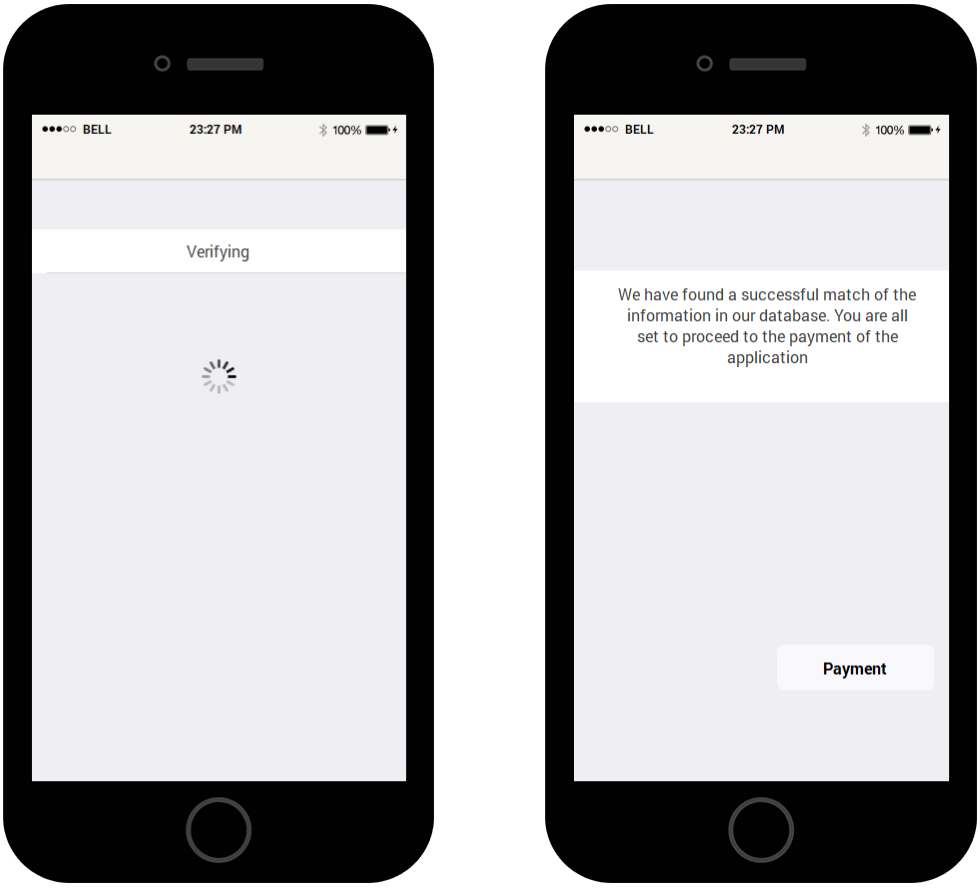
The following screen shows how this service can be easily leveraged on a mobile device.



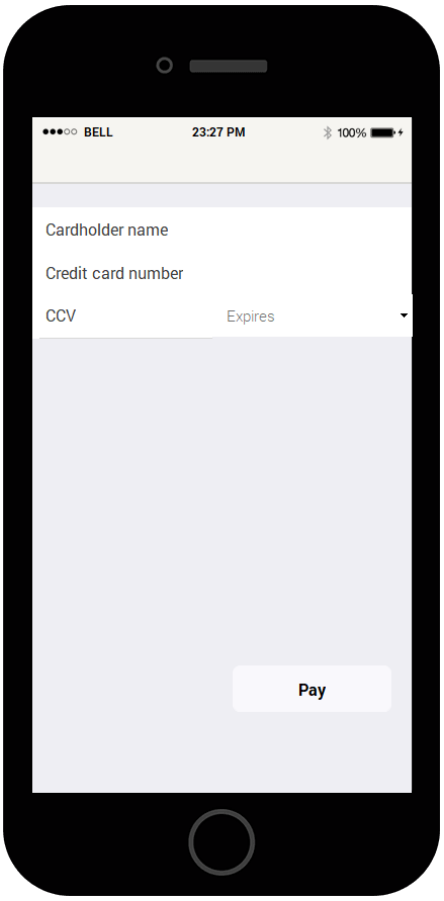
The screen of the page demonstrates the simple login and signup options.

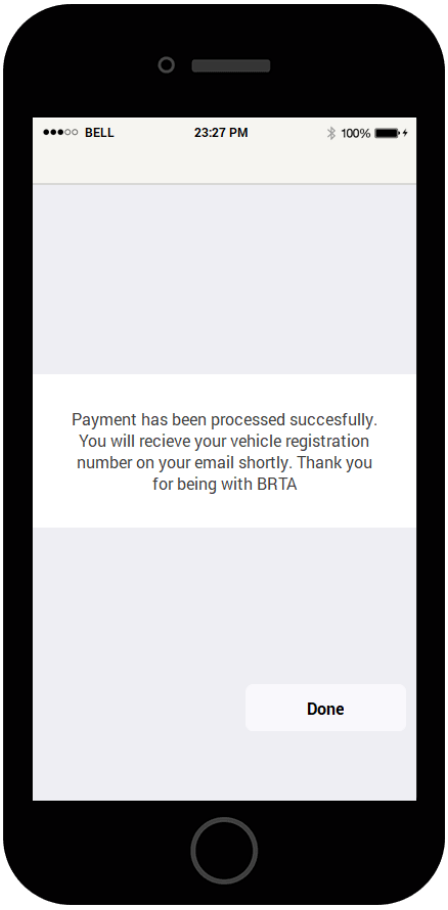


The screens above shows the registration form for both general and technical information of the vehicle such as vehicle information, purchase information and insurance.



Upon submitting the request, a simple API call will try to match the information provided by the user in the blockchain database. In this prototype the system can find all the relevant data by the NID number of the citizen which is the primary key and pull up vehicle and purchase related data. One the system verifies there is a data match the user can proceed to payment part of the process





Here just like any other online payment, the user will pay the relevant fee for the registration. Upon doing that, an email will be sent to the user with the vehicle registration number and ready to print the license plate.

6 Results and Discussion

Blockchain implementation in the vehicle registration process will have a big impact in the society. It will also open the door for other sectors of government to adapt blockchain and establish a secure and transparent government.

6.1 SWOT analysis:

Before implementing blockchain, all key issues affecting the proposed idea should be considered. analysis should be used also for evaluation of such implementation. Strengths and weaknesses are internal, coming from the service features and characteristics. While opportunities and threats are external, referring to factors like market, competitors, legislation, technological developments, etc.

- **Strength**:
  01. First time implementation using blockchain technology in Bangladesh.
  02. Viewing and tracking of vehicle data for the customers free of charge.
  03. Data is available for researches to analyse and use that analysis for making the system sustainable.
  04. Coordination between different sectors of business.
  05. Bringing down the time to register a vehicle by 90%
  06. Notification of a vehicle reaching a critical physical condition and prompt the customer.

- **Weaknesses**:
  01. Data can be used for business purpose such as advertisement, promotion.
  02. Minimal protection of a data centres.
  03. Low level infrastructure can slow down the process
  04. Lack of knowledge about IT and blockchain can hamper productivity

- **Opportunities**:

  01. Providing secure vehicle registration system

  02. Development of self-sustaining revenue model

  03. Using the same model to implement blockchain in other sectors of government.

  04. Liaise with other countries in helping them adapt blockchain thus forming stronger alliances.

- **Threat**:

  01. Lack of finance and resources

  02. Security of the data

  03. Lack of skill of personals

  04. Change of power in the government is a concern to veto the whole project for political benefit.

  05. Natural disasters which is a common problem every year in Bangladesh can make damage in the data centres or infrastructure and slow down the project.

  06. Large electricity consumption of blockchain database.

On the other hand, according to BTRC number of individuals using the internet as of January 2019 is 90.421 million (Bangladesh Telecommunication Regulatory Commision, 2019) which is 56.25% of the whole population. But most of these internet users live in the big cities and the capital Dhaka.

Based on this percentage and concentration of population in Dhaka, we can assume the service needs to be implemented in the major cities like Dhaka first or new system will lose return on investment as less people will use it. Later on, the service can expand to other regions of the country.

As mentioned in section 3.5, Bitfury and Georgian government's collaboration for transforming land registry with blockchain will bring down the cost for land registration from $50-$200 USD to $0.05-$0.10 USD for buyers and sellers, which is almost zero (Kshetri, 2017).

If implemented in vehicle registration system in Bangladesh, it can also be assumed that the cost of vehicle registration will come down drastically from the range of 1500-98000 BDT (Authority, 2019) to much lower cost depending on the size and type of the vehicle.

7 Conclusion

The main aim of the thesis was to investigate scope of blockchain in the vehicle registration system in Bangladesh. Information about blockchain in general and current situation of e-government in Bangladesh was analysed by reviewing existing literature in this field. In the practical part current vehicle registration system was described and overview of how the system can be transformed into a digital one with blockchain capability was discussed.

In addition, an overview of any examples of successful blockchain implementation in both developed and under-developed countries was created. Prototype of the mobile application was designed based on the literature review in order to show its usability for easier and faster registration process. However, due to lack of access to internet for majority of the population it can be said, the government has to implement such technology in a smaller scale first. Dhaka, the capital would be the best place to be introduced with a new system as the rate of internet users, vehicles and literacy are higher there

Such service proposed in the thesis will transform the ever so old government system for Bangladesh. It can facilitate other government organizations to adapt with blockchain based system where there will be less chances of corruption, bribery and bureaucracy. Thus, helping the government sector to be more robust and trustworthy for the ordinary people.

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