

PopVote: A Revolution in Gathering Opinions in Hong Kong

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Abstract

Electronic ballots and online voting is becoming popular around the world. In the US Presidential Election of 2012, over half of the states allowed some form of online voting. In the modern but less than fully democratic society of Hong Kong, large scale e-voting is almost not heard of, until March 23, 2012 when the authors of this paper designed and conducted the “PopVote 3.23 Civil Referendum” project under the umbrella of its “PopVote” Programme. It was virtually a mock referendum for people to vote for the Chief Executive of the Hong Kong Special Administrative Region two days before the real “election” by a “small circle committee” of 1,200 members. At the end, over 220,000 Hong Kong people voted, despite the online voting system being paralyzed by “high-level cyber attacks” at the beginning. The event drew widespread attention from the local public and the international media, as tens of thousands of people queued up at polling stations to cast a vote, electronic or otherwise, which is not counted in the real election. This presentation examines the infrastructure of the online voting system used for the “PopVote 3.23 Civil Referendum”, focusing in particular the identity authentication, privacy and security issues involved. The authors also discuss some of the challenges encountered in designing and carrying out the operation. The findings are of interest not only to those developing online voting/survey technologies, but more broadly to the public opinion research field in terms of our understanding of how to engage respondents in a technology-driven world. Such a development is particularly relevant to collect public opinion in Hong Kong and other less democratic societies without a referendum system. The “PopVote 3.23 Civil Referendum” project pioneered a revolutionary method in the Asian region to collect public opinions via an electronic public voting system.

Keywords: civil referendum, democracy, electronic voting, identity authentication, privacy, security, *HKU POP, Hong Kong*

PopVote: A Revolution in Gathering Opinions in Hong Kong

Introduction

Background on Democratic Development in Hong Kong

Democratic development have been a major topic of public discussion in Hong Kong since it became a Special Administrative Region (SAR) of the People Republic of China (PRC) in 1997, when its sovereignty was transferred back to PRC after one and a half centuries of British rule. According to the Sino-British Joint Declaration (1984) and the Basic Law, which is often considered as the mini-Constitution of Hong Kong after the transfer of sovereignty, the region will retain its political, economic, and judicial systems along with its unique way of life. It will also continue to participate in international agreements and organizations as a dependent territory for at least 50 years after the handover. However, despite the PRC central government's emphasis on a "high degree" of autonomy granted to the SAR, "Hong Kong's political development has lagged in the face of well-documented PRC efforts to impede progress toward direct elections, universal suffrage, and other democratizing reforms that Beijing fears might loosen its control" (Sing, 2009). According to the tracking survey conducted by the authors on people's satisfaction with the government's performance on the pace of democratic development, the latest half-yearly figures stand at 22% satisfied and 50% dissatisfied, giving a net satisfaction rate of negative 28 percentage-points (Public Opinion Programme, the University of Hong Kong, 2013).

It is almost common sense that universal suffrage is the key element of democracy. However, in Hong Kong, after decades of struggling, people are still waiting to see the

implementation of universal suffrage at the level of their Chief Executive (CE). Under the Basic law, CE as the head of the government is assisted in policy making by an Executive Council (ExCo), which consists of members appointed by the CE. There is a Legislative Council (LegCo) serving as the law-making body of the region, which comprises 70 members, with 35 elected directly by geographical constituencies and 35 elected by functional (i.e. occupation-based) constituencies. On a more regional level, there are 18 District Councils (DC) comprising 102 appointed members and 405 elected members. The councils undertake improvement projects and promote recreational, cultural and community activities in their respective districts.

Hong Kong people are permitted to elect some members of the legislature under full suffrage since 1991, but the development in this aspect appeared to be slow after that. Two decades have passed, universal suffrage is only applied to some but not all of the DC and LegCo seats, while the CE is elected by a committee consisting of just 1,200 members mostly drawn from functional constituencies, religious organizations, municipal and central government bodies.

On 1 July 2003, triggered by the controversy over the proposed local legislation of Article 23 of the Basic Law (to prohibit any act of treason, secession, sedition, subversion against the PRC Central Government), over half a million people took to the street and the governance of the HKSAR government under Tung Chee-hwa, the then CE, suffered a severe plunge. The pro-democracy forces stepped up their campaign for electing the CE and the LegCo by universal suffrage, and they scored important success in the 2003 DC elections and the 2004 LegCo election. After rounds of negotiation, the PRC Central Government finally promised Hong Kong people that the universal suffrage “may” be used for CE election in 2017, and for the LegCo election in 2020. However, the Central Government later revealed that it may have a different interpretation of universal suffrage from the people of Hong Kong, as it spelt out a nomination

requirement near the end of 2012 that the CE candidate must “love the nation and love Hong Kong”. This aroused heated debates in the society and triggered several campaigns for “genuine” universal suffrage. In early 2013, a civil disobedient movement was initiated by a professor of law at the University of Hong Kong, who proposed to mobilize at least 10,000 citizens to “take over” Central, the core downtown district in Hong Kong, in the summer of 2014 if the government fails to come up with a plan for universal suffrage which complies with international standards.

Public Opinion Polling in Hong Kong

The earliest library records in existence of public opinion polls in Hong Kong date back to the late 1970s. Then in the 1980s, a research company began a series of polls on district administration, governorship, public confidence, while the Government also set up a survey office to collect public submissions in response to its public consultation on political reform. However, the age of public opinion polls in Hong Kong really began in 1991, triggered by the first time ever LegCo direct elections. From then to now, polling in Hong Kong is almost completely free from any legal restriction, but standards vary. Different from many developed countries, the academia rather than media is the main driving force of polling development, whereas market researchers and think tanks play a supplementary role in terms of public opinion polling initiatives.

Riding on the tide of democratic development, one of the authors in June 1991 established the Public Opinion Programme (POP) at the University of Hong Kong, with a primary objective to collect and study public opinion on topics which could be of interest to academics, journalists, policy-makers, and the general public. The programme is the first of its kind established by an

academic institution in Hong Kong. By May 2013, POP has conducted over 1,500 independent surveys, mostly supported by project funding. Common types of studies conducted by POP include random telephone surveys, face-to-face interviews, mail surveys, online surveys, household surveys and focus groups, while its areas of interest include electoral studies, government policies, media performance, as well as general political, social, livelihood and health issues. After twenty odd years of operation, POP has become an icon of opinion study in Hong Kong. While striving to produce scientific research outputs with a high degree of integrity and quality, in order to keep abreast of emerging new technologies in the world, it has taken a number of new initiatives in the area of opinion studies, including deliberative polling, mass engagement as well as electronic platforms. The authors share in this paper their experience of an unprecedentedly large-scale electronic civil referendum and examine the impact and implication of this exercise to the political environment and public opinion gathering in Hong Kong.

“PopVote 3.23 Civil Referendum”

Background and Objectives

To echo with the 2012 CE election held on March 25, supposedly the last time a CE is elected by a 1200-member Election Committee before universal suffrage is implemented in 2017, POP organized a mock civil referendum entitled “PopVote 3.23 Civil Referendum” on March 23 for the general public to express their support towards different candidates, with three objectives, namely, 1) to provide a multi-dimensional reference for the public and the election committee, 2) to construct a civil society by promoting civil participation, and 3) to demonstrate the electronic voting system.

The “PopVote 3.23 Civil Referendum” project was funded entirely by public donations. By design, all local citizens of age 18 or above were eligible to cast a vote on an electronic voting platform hosted by POP, via internet or smartphone app, during 00:00 to 20:00, or in the designated territory-wide physical polling stations from 09:00 to 21:00 on Mar 23. The voting time was subsequently extended to 18:00 of the next day because of overwhelming response from the public as well as a system interruption in the middle of the event caused by vicious attack. Nevertheless, a total number of almost 230,000 votes (222,990) were collected at the end. Among these votes, more than half (55%) were “abstention” or “blank vote”, implying a preference of aborting the CE election. The event was widely covered by local and international media and received much more public attention than anticipated.

[Table 1 Votes collected in “PopVote 3.23 Civil Referendum” by type of channel]

	Number of votes	Percentage
Polling Station	85,154	38%
Website (popvote.hk)	66,005	30%
Smartphone App	71,831	32%
Total	222,990	100%

[Table 2 Comparison of results between Official 2012 CE Election and PopVote 3.23 Civil Referendum]

	Official 2012 CE Election	PopVote 3.23 Civil Referendum
Leung Chun-ying	689 (57.4%)	39,614 (17.8%)
Henry Tang	285 (23.8%)	25,452 (11.4%)
Albert Ho	76 (6.3%)	36,226 (16.3%)
Abstention	Not available	121,580 (54.6%)

System Interruption

Not long after voting commenced at midnight of the event day, network congestion was observed as electronic votes flooded in. Despite the slow loading speed of the system at times, more than 10,000 votes (13,682) were received in the first 7 hours, from 00:00 up to 07:00, before the electronic voting system came to a complete halt due to some abnormal network traffic subsequently diagnosed by the IT experts in the research team.

A contingency plan was then executed and publicly announced via media broadcast (television and radio) and volunteer networks. The public was informed of the system failure, and paper ballots would be used as a substitute. Because of the public's extremely active participation, long queues started to appear at all physical polling stations. The research team later decided, and again announced via media broadcast, that voting hours would be extended for one more day and that the results would be announced at the midnight before the real election.

Meanwhile, the research team quickly called for help from IT security experts after the abnormal network traffic was detected. After hours of investigating, four IP addresses were suspected to have directed Distributed Denial of Service (DDoS) attack to the voting system. The research team reported the case to the Hong Kong Police Force near midnight on March 24, and two males were arrested on the same day. One of them subsequently pleaded guilty to the charge of attempted criminal damage, one year after the event.

Electronic Voting System Infrastructure Review

After the event, the entire voting system was reviewed along three dimensions, namely, risks, challenges, and remedial strategies.

Risks

There are six principles in designing and developing a voting system, namely, availability, uniqueness, fairness, eligibility, privacy, and integrity. However, in most of the cases, taking care of all six principles in the design of one system is a very challenging task.

Take this “PopVote 3.23 Civil Referendum” event as an example, “availability” refers to a functional system that would be available during the event period. Factors that could affect the availability of the system include power and network interruption, human faults and hacker attacks. As for “uniqueness”, the system should identify and prevent duplicate vote from any individual voter. Theoretically, Hong Kong SAR Identity Card (HKID) number should be the most trustable unique identifier. However, history tells that these numbers can be faked. Regarding “fairness”, the system should be able to prevent anyone from altering the database and thus the results. For example, the system should be able to prevent hackers from making use of glitches to bypass security checking and implanting malware to the system. When it comes to “eligibility”, the system should be able to verify the identity of the voter, while this is as challenging as is depicted in the famous cartoon captioned as “On the Internet, nobody knows you’re a dog” by Peter Steiners, published in *The New Yorker* on July 5, 1983. Concerning “privacy”, the system should ensure the ballot information and personal data submitted by the voters are well protected. However, the ballot and personal information of the voter cannot be completely delinked because of the need of checking for uniqueness. Last but not least, “integrity” refers to the safeguarding of all data collected by the system.

Challenges

Two days before the event, the voting system detected rounds of abnormal traffic with one million data packets per second, which were suspected to be DDoS attacks. The heavy traffic

halted the network for a few minutes each time. DDoS attack is very difficult to prevent because the sources of traffic usually look genuine and massive.

About the same time, many members of the research team received emails from strangers with some suspicious attachments in the few weeks prior to the event, which could have been attempts of implanting malware onto the research team's machines by the attackers. Less security cautious people fall into such traps easily, and backdoors for attack would thus be created. Staff training and good security policy are essential to overcome this challenge.

Meanwhile, two team members' email accounts were hijacked just a few days prior to the event day, and the team members concerned could not login their email accounts. It is possible that important information transferred via the two mail accounts, including the system infrastructure design and other related data, might have been retrieved by the hackers. This implies that even internal communication channels may not be completely safe. One way to ensure information confidentiality is to encrypt all files with secure passwords, however this is not a user friendly way and users usually just do not bother to do so.

Predicting the size of data traffic is another difficult task. With limited resources to build a robust platform that can handle astronomical traffic, a good and realistic estimation on the traffic size is essential for the research team to design the amount of resources to be invested in the platform. However, estimating the number of people to be engaged in such an event could be very challenging due to the ever changing political environment and thus public sentiment. Good analysis on the political situation and swift decision are essential to tackle this problem.

Remedial strategies

Possible remedial strategies to be taken in future are discussed under the each type of risk, plus physical station security.

On “availability”, the voting system was placed at a “computer cloud” hosted by the University of Hong Kong, which is equipped with firewall and intrusion prevention system. The front-end is protected by a cloud security service that allowed specific geographical location blocking to deny non-Hong Kong network access. This limited overseas network access and greatly mitigated DDoS attacks. At the same time, a remote backup server was set up in the premises of the research team to provide resilience to the system against DDoS attacks or any system failure of the Cloud.

On “uniqueness” or “identity authentication”, all citizens of Hong Kong are eligible to apply for a personal electronic-certificate for identity authentication purpose when needed. However, the usage of this e-cert is not yet common in the society. Therefore, in order to cater more voters, using this method for identity authentication was ruled out at a very early stage of system design. Taking into consideration the pros and cons of a number of authentication methods, a combination of HKID number and mobile phone number was adopted for online authentication. Voters were requested to submit their full HKID and mobile phone numbers to the system for an SMS verification process. Only those who passed the verification process were allowed to cast their votes. SMS verification is a popular method to verify the identity of a user on the Internet. Popular applications like Facebook, Google and WhatsApp also adopt this method. In the PopVote case, instead of sending out confirmation SMS by the voting system, it was the voters themselves who were required to send the SMS together with the verification codes shown on a computer screen. A reverse flow was designed in the hope to prevent users from repeat verifications that thus increase the burden of repeat submission by an economic factor.

On “fairness”, the PopVote system automatically logged all data insertions and altering actions, and only authenticated users could perform data insertion. The comprehensive log records serve the purpose to ensure the fairness of the voting exercise.

On “eligibility”, while a flawless system to identify one’s identity on the Internet is yet to be developed, the research team believed casting votes at physical polling stations could totally prevent the faking of eligibility as the real HKID Card with a photograph of the card holder could provide sufficient information for the polling station staff to verify the eligibility of each voter.

On “privacy”, personal identification numbers of the voters were only used to authenticate the individuals’ identities and check against multiple voting attempts to the system, and once the personal HKID numbers were submitted to the system, they were converted into series of hashed codes using the U.S. Federal Information Processing Standard cryptographic hash algorithm SHA-512 designed by the U.S. National Security Agency (NSA). This is to make sure that even if the data were stolen from the PopVote server by hackers, it could not be decoded. Even the IT experts in the research team could not reversely reconstruct the hashed codes into the original personal data. SSL certificate, issued by a trusted certificate authority HongKongPost, was installed in the PopVote server to ensure the data transmitted between the server and the end user was encrypted using PKI cryptography, an international standard for encrypted data transmission. This is to prevent man-in-the-middle attack, so that even hackers could not retrieve the ballot information and voter’s personal data. All developers, who could access the programming scripts or the server, have pledged to make no attempt to reverse any hashed data, and no mapping of identities and votes would be done under any circumstances. All hashed format of personal data was destroyed and removed from the system within one month after the voting event.

On “integrity”, the PopVote server was protected by firewall, intrusion prevention system, and cloud-based web protection services. The voting platform was also equipped with a virtual keyboard to avoid any keylogging software from logging credentials keyed in by physical keyboard. The device used for casting vote was an interface connected to the PopVote server. All data were stored in the server-side, and no personal data and ballot information were stored on the voting device. This prevented attackers from making any intrusion to the data.

Finally, on “physical station security”, voting devices were assigned to the physical stations for logging in to the PopVote system. The PopVote system used at the physical stations was a tailor-made system with special access control and user interface. Each station helper was assigned with a unique pair of user ID and strong password to activate the PopVote system. Mismatched entry would be rejected when accessing the system. Each station helper was bound to activate just one voting device, any subsequent activation will automatically deactivate the previous one. All these mechanisms were installed to secure the PopVote system.

Recommendations for future development

Having reviewed the infrastructure of the electronic voting system, the authors would like to make some recommendations regarding the software, privacy, performance and uniqueness aspects of the system.

Software

Use lightweight and efficient programming language to handle web requests. Node.js is one of the most popular event-driven programming languages to build scalable network applications and data-intensive real-time applications that run across distributed devices.

Privacy

Increase the hashing security level to prevent the hashed data being reconstructed. A random salt can be added to data before hashing to make it difficult to work out the original data by the hashed pattern, while iterating the hashing process a few more times will increase the difficulty of hacking.

Performance

When the system fails to handle the web traffic, some sort of notifications should be provided to users. A fault-tolerant system can be deployed to continue serving a web page, and to display the status of the server to the web visitors.

Uniqueness

Electronic certificate acts as an electronic identity card for each individual in Hong Kong. However, the current penetration rate in Hong Kong is quite low. The Government should promote its usage in order to prepare the public and service providers for the future when most voting, trading, and other official communication will be conducted via the Internet.

Conclusion

In spite of its mechanical failure, the PopVote 3.23 Civil Referendum has no doubt engaged the community heavily into discussing the 2012 CE election, despite the fact that members of the general public did not have the right to vote. Besides the near 230,000 people who had casted their votes in the civil referendum, hundreds of volunteers were also involved in different stages of the campaign including on-site works. In terms of promotion prior to the event, besides making public announcements at press conferences, the research team relied heavily on the people's voluntary promotion and mobilization via popular social media like Facebook,

Twitter, Google+, Weibo, and so on. Without paying any advertisement, a few days after the smartphone app was launched, more than 200,000 users downloaded it. At the end, votes casted via smartphone app and Internet accounted for 32% and 30% of all votes collected. Wide media coverage on hacker's attack on the system have actually aroused people's dissatisfaction of the electoral system whereby they have no say in selecting the CE. Eager to make their voices heard, hundred of thousands of them decided to get on their feet and cast a vote with no real power. The event inspired many social activists to use civil referendum as a means to press their demands. At the time of writing this paper, one such campaign is brewing, whereby the organizers would like to use civil referendum to mobilize the public into endorsing some popular proposals for the next CE election in 2017.

To conclude, the unique political environment of Hong Kong under the "one country, two systems" formulation has induced the development of political participation and public opinion expression beyond random sample surveys and direct elections. While the general public is considered to be mature enough for universal suffrage, they are not offered the right to elect the head of their own government. Under such circumstances, the "PopVote 3.23 Civil Referendum" provided a platform for the public to articulate their needs. When technology becomes more advanced, especially in the areas of identity authentication, privacy protection and availability, electronic voting in the form of civil referendums will become more and more important in Hong Kong. When this "Hong Kong experience" becomes mature, it may have significant impact on other not so democratic societies without universal suffrage and without official referendum. In a way, the electronic-based "PopVote 3.23 Civil Referendum" project has pioneered a revolutionary method in the collection and expression of public opinion in the Asian region, if not the whole world.

References

- Brody, M. (2012). *Voting Rights and Wrongs: Philosophical Justification for Universal Suffrage*. CMC Senior Theses. Retrieved from http://scholarship.claremont.edu/cmc_theses/418.
- Cheung, P.T.Y. (2012). The Changing Relations between Hong Kong and the Mainland since 2003. In, Lam, W.M, Lui, P. L.T., Wong, W (Eds.), *Contemporary Hong Kong Government and Politics* (pp. 325-344). Hong Kong: Hong Kong University Press.
- Chung, R. T. Y. (1993). Public Opinion. In Choi, P. K. & Ho, L. S. (Eds.), *The Other Hong Kong Report 1993* (pp. 401-423). Hong Kong: The Chinese University Press.
- Chung, R. T. Y. (1994). Public Opinion. In McMillen, D. H. & Man, S. W. (Eds.), *The Other Hong Kong Report 1994* (pp. 103-123). Hong Kong: The Chinese University Press.
- Chung, R. T. Y. (1994). Public Opinion in the Late Transition Period. In Cheng, J. Y. S. & Lo, S. S. H. (Eds.), *From Colony to SAR: Hong Kong's Challenges Ahead* (pp. 491-526). Hong Kong: The Chinese University Press.
- Democratic Development in Hong Kong. (n.d.). In *Wikipedia*. Retrieved May 1, 2013, from http://en.wikipedia.org/wiki/Democratic_development_in_Hong_Kong.
- Elections in Hong Kong. (n.d.). In *Wikipedia*. Retrieved May 1, 2013, from http://en.wikipedia.org/wiki/Elections_in_Hong_Kong.
- Joyent, Inc. (2013). *Node.js programming language*. Retrieved from <http://nodejs.org/>.
- Legislative Council Secretariat. (2013). *Legislative Council elections*. Retrieved from <http://www.legco.gov.hk/yr12-13/english/sec/library/1213in01-e.pdf>.
- On the Internet, nobody knows you're a dog. (n.d.). In *Wikipedia*. Retrieved May 1, 2013, from http://en.wikipedia.org/wiki/On_the_Internet,_nobody_knows_you're_a_dog.

Politics of Hong Kong. (n.d.). In *Wikipedia*. Retrieved May 1, 2013, from http://en.wikipedia.org/wiki/Politics_of_Hong_Kong.

Public Opinion Programme, The University of Hong Kong (2013). *Popularity of the Government (Module code: 07). POP Polls*. HKU POP Site. Retrieved from <http://hkupop.hku.hk/>.

Registration and Electoral Office. (2012). *The Fourth Term Chief Executive Election*. Retrieved from <http://www.elections.gov.hk/ce2012/eng/result.html>.

SHA-2 Hashing algorithm. (n.d.) In *Wikipedia*. Retrieved May 1, 2013, from <http://en.wikipedia.org/wiki/SHA-2>.

Sing, M. (2009), Hong Kong's Democrats Hold Their Own. *Journal of Democracy*, 20 (1), 99-112, doi:10.1353/jod.0.0046

Universal suffrage. (n.d.). In *Wikipedia*. Retrieved May 1, 2013, from http://en.wikipedia.org/wiki/Universal_suffrage.