ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

ADVANCED COMMUNICATION SOLUTION FOR COMMUNICATION OF CITY GOVERNMENTS TO ITS CITIZIENS

Jozef Pavlov, Miroslav Michalko
Department of Computers and Informatics, Technical University of Košice, Slovak Republic

DOI: 10.5281/zenodo.884115

ABSTRACT

In this paper, the advanced solution for improving the communication between municipalities and its citizens using mobile software solution is presented. Presented research covers the overview of available technologies for the client-server based communication and further presents their comparison. Different projects that aimed to improve interaction between citizens and municipalities are introduced. Except for the improvement, this study also analyzes weak points of the analyzed solutions. Another point of interest is live streaming and its use with appropriate protocols on mobile platforms such as Android or iOS. Security of streaming server Wowza Media Systems is also part of research. Suitable technologies for client-server communication, applicable improvements for municipality-citizen communication and eligible streaming protocols were subsequently picked and deployed in the solution. Proposed solution is experimentally verified in the form of mobile application for devices with operating systems Android and iOS called Poprad Naživo. This application allows citizens to interact with parliamentarians of city council in Poprad in the real time. Implementation covers three main functionalities including live streaming, discussion and voting. All proposed functionalities and their reliability were experimentally tested and prove the proposed solution to be usable and ready to be implemented in the real-world environment.

KEYWORDS: Android, citizen, communication, iOS, live streaming, municipality

INTRODUCTION

Political life in every city should be easily available to all the citizens. It is their very right to see how parliamentarians debate and change the rules. However, many cities offer just one option for citizens to be part of political life of their city, and this option is to visit sessions of city government by person. This could introduce problems with insufficient capacity or accessibility. Solution for these issues may be mobile application, which is to allow citizens watching live stream of municipality gathering from almost anywhere.

When finding advanced solution for improving communication of city governments and citizens, many existing projects and theories could be helpful. E-government is worldwide known project, which utilizes Internet and internet technologies to improve interaction between governments and citizens. On the low development level, e-government can provide useful information and services for citizens through the web, or nowadays very popular mobile applications. Utilization of e-government and development of the mobile applications allow users to watch live stream and actively participate in political sessions through the Internet.

Mobile applications used for that purpose are part of larger complex system for city government. It contains smaller system for camera control and providing captured video to the streaming server. It is also able to identify active speaker while reading his name from informative table using OCR technology. Another part of system focuses on objects detection in streaming and identification of person using face recognition techniques. Proposed system represents solution for city governments that improves communication with citizens. Main purpose of this complex system is so to enhance services of city not only for citizens, but for city parliamentarians as well.

The system is divided into smaller parts and thus the communication between these parts has to be arranged. Nowadays, client-server communication based on request-response is popular. This type of communication is useful only in case when server does not need to notify client side whenever it wants to. Opened and persist communication is suitable for this purpose. Communication for data streaming is needed as well because of live video streaming function in mobile applications.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

GOALS AND MOTIVATION

The main goal of this research is analysis of available technology solutions that can be applied in the chosen city (city of Poprad in our case) to improve communication between city and citizens. Current technologies for video stream delivery, communication between mobile client and server and streaming security are analyzed. This study concentrates on modern software solutions and designs own implementation that is the result of consistent analysis of current state of IT equipment in meeting room of parliament in city Poprad. The experimental implementation is represented by three individual parts that together can enhance services of city for their citizens and parliamentarians.

ANALYSIS

As stated above, the analysis of available technologies and applicable models are needed for development of appropriate solution. Bearing this in mind, this section will contain analysis of modern client-server communication technologies, existing solutions for improving city-citizen interaction, streaming protocols and security.

Client-server communication

Analysis of different types and technologies for this communication is necessary prior to the development of mobile application, which should communicate with server side through the Internet. One of the principal difficulty to solve is communication in terms of sending requests to server and receiving responses or has opened, persist and bi-directional data transfer. Once selecting suitable type of communication, there are plenty of technologies that can be used.

Results of this research is mobile application with functionalities live stream playback, discussion and voting. For that purpose, combination of both mentioned types of client-server communication is required. Request-response communication is used for sending discussion messages and sending votes, on the other side, open and persistent is suitable for receiving broadcasted discussion messages and votes.

In case of the request-response communication, the well-known and popular technologies that could be used is Simple Object Access Protocol (or SOAP). SOAP is the protocol for exchanging messages in decentralized and distributed environment [1]. These messages are called SOAP messages and they are based on XML format. Message exchanging is possible with transfer protocol such as HTTP or SMTP between SOAP client and SOAP server. From the perspective of choosing SOAP technology for communication between mobile clients and server, main problem is that SOAP was designed before mobile applications were so popular. According to Cox [2] there are specific disadvantages, when using SOAP with mobile client:

- Change control - This problem occurs when SOAP services are changed. Updating web client should not be difficult but with mobile client it can be problematic.
- Complexity - Generating SOAP client code from WSDL language may be complex. Even when it must be generated for more than one mobile platform.
- Security - Because of fact, that SOAP specification was transport-independent, security of communication can be reached with using special SOAP methods included in WS-Security. However, this means extra processing for developers.

Another technology for communication based on request-response model is REST, which was created with purpose for design and development of web services. According to Cox [2] is REST the best option for client-server communication with mobile client and there are multiple reasons for that. The first one is that REST was designed to work with thin client as a browser, and is also platform independent. Standard format for REST messages is lightweight JSON, which is supported by most of the popular mobile platforms, e.g. Android and iOS. On the other side, some problems could occur while working with REST. Talking about security of communication, REST relies on HTTP/HTTPS protocol and its build-in security mechanism. For this reason, is good to lean on best practices, e.g. never send user credentials from server to client.

Technologies mentioned above are based on request-response paradigm. However, this principle does not allow sending data from server without client requesting it. For this purpose, Push (also called Comet) technologies were created. One of the most popular Push technologies is Long polling technique. Its main goal is to keep HTTP connection opened till server gets requested data for client. Once the data are received the connection is closed and reopened by sending another request to server. Another Push technology is Server Push, which was introduced together with HTTP/2 and was created to provide improvement of client-server communication line. Feature called multiplexing allows using single communication line for transferring more than one message at the same time. Thus, server can send data to client's cache and client does not need to request for any additional files, for

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

example JavaScript and CSS files, after loading HTML document. Instead, server sends all additional data to client proactively. Disadvantage of this technology, according to Denis [3], is missing API for mobile applications. Probably the most popular way to communicate with open and persist connection is through WebSocket. Before WebSocket, whole communication had depended on HTTP protocol, which does not support bi-directional communication. However, more and more applications, like online games and chat apps, were demanding this type of communication and that is when the WebSocket came as a solution. It uses single TCP connection for transferring messages in both ways. It also was not designed to replace HTTP but to bring new possibilities to client-server communication [4].

Possibilities for improving communication: municipality-citizen

Improvement of city services using internet technology requires understanding of e-government principles. Providing such services through the Internet is still more and more popular and as McClure said [5], e-government has potential to improve the relationship between citizens and government institutions. Basic principle of e-government is in technologies – particularly web-based applications, to ease access to government's services and information. E-government is divided to four development stages:

- cataloguing,
- transaction,
- vertical integration,
- horizontal integration.

In the first stage, i.e. cataloguing, the institutions are up to present themselves on the Internet. Most of the governments use web application for this purpose, however the result is often insufficient. Web pages of institutions contains only little information about their services and activities. This is because of very poor expertise and experience with internet technologies. Improvement came with putting electronic documents on institutions web pages, which were available for reading and downloading. Basic attribute of these documents was their organization (cataloguing), and hence this stage was named cataloguing [6]. Main initiators for applying cataloguing stage on governments or city institutions were citizens, media and technology-literate employees. Another reason is a fact, that if people can reach information about institutions from third party resources, they expect the institution to provide this information. Web presence of institution is also benefit for both sides, citizens and institution.

Point of interest in second phase is to connect inner institution system with online interfaces [6]. This allows citizens to make necessary transactions online. Goal of transaction stage of e-government is so to connect databases with online interfaces and make possible to pay bills or get license electronically. In ideal case, this stage ensures making electronic transactions without any help of staff.

Last two stages are about integration of basic processes not only across different government levels but across the different government functions. With this integration, citizens can make any transaction by contacting any office or institution since they are all interconnected. This concept is also called one stop shopping concept. Effort of vertical integration in this concept is to transform institutions services, instead of automatization and digitalization of already existing processes. According to Lee [6], it is necessary to make permanent changes in in very government processes that can lead to total change of its concept. Making institutions available online in this stage is just not enough. On the other side, horizontal integration is focused on full exploitation of information technologies potential in favor of government institutions. Sharing of information between these institutions is possible to achieve through the creation of communication channel among institutions databases. Thus, horizontal integration of institution services across government offices is achieved.

Applying the first stage of e-government on city government can result in possibility of citizens to watch online live streaming. In Slovakia, there already are some projects providing such functionality and as a result analysis of this projects is necessary before creating own implementation. First presented solution is web portal zastupitelstvo.sk, which provides streams from cities or urbans governments sessions. It also offers archive with videos from up to 30 cities in Slovakia. Main advantage of portal is that all videos are divided by themes allowing users to play only the part of video. Portal also offer optimized video playback for mobile devices. As main disadvantage can be considered chat, that is common to all streams and videos. Another similar solution is portal TV ESO, by ESO MEDIA company. Company provides live streams and archives videos from city governments of six cities in Slovakia. This portal offers same functionalities as previous one, except for the chat. These two solutions follow the first stage of e-government. Please bear in mind that citizens have no, or only partial, options to actively participate on sessions.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Streaming is, according to Costello [7], technology for delivering video and audio content through Internet. It is considered as a fast way of obtaining Internet content, because stream of data is continuous. Live streaming is type of streaming, where video or audio content is delivered and broadcasted in real time. Broadcasting of stream is available through stream protocols. Example of stream protocol can be RTP protocol. It is a transport protocol and was designed for transmitting video and audio content in real time. Because of fact, that this type of transmission is delay-prone [8], RTP was built on mechanism of lightweight UDP protocol. When packets are lost during communication, sending continues without the effort to resend lost packets. Data transmission is one directional, from server to the client. Android and iOS native players do not support RTP stream, however the solution can be found in third party applications like RealPlayer for Android. Another protocol, familiar to RTP, is RTCP protocol. Its main job is providing feedback about data distribution quality [9], it does not transmit any data. In contrast with RTP, RTCP is bi-directional, so client can request quality of streaming video. RTP protocol also works with RTSP protocol, which serves to bind communication between server and client and is used to care about client request to server, for example to play or stop video. Next protocol, RTMP, was built on TCP and offers persistent connection. Thanks to that attribute, bi-directional transmission of data is guaranteed in single RTMP connection [10]. In the same way as RTP, it is not supported by native Android and iOS players, however solution is also same, i.e. third party applications. Protocol which is supported by native iOS players is HLS (HTTP Live Streaming) protocol. HLS arose in time, when HTTP with protocol that support adaptive data streams became suitable for streaming. Bearing in mind that HTTP with TCP/IP were designed for reliable communication and not long connections, this principle was considered as unacceptable. But nowadays, in time of high-speed communication is that fact irrelevant. HLS was invented by Apple company for their platforms iOS and OSX and it is not very supported outside of their products.
Steaming is enable when captured video and audio content from cameras is transmitted via streaming protocols to streaming server, then the content is subsequently delivered to end devices. Example of such a server is Wowza Media Systems. To secure stream server, there are some mechanisms like securing server with name and password, token, certificate, DRM or by limiting the accessibility.

SOLUTION AND RESULTS

The purpose of the research [11] was to find advanced solution for communication between city governments and citizens, design and implement own solution and eventually carry our experimental verification. Entire solution (Figure 1) is represented by three separate parts that form together a system for municipality of city Poprad. The first part of the research [12] is responsible for cameras control in object of city governments sessions and recognition of actively speaking parliamentarian by reading name of person using OCR technique. Due to this feature camera controlling system can be fully automatized. Captured content form cameras is subsequently transmitted to Wowza Media Systems streaming server where broadcast to end devices can be realized. Subsequent research [13] on system then processes streamed video and tries to identify speaking person using face recognition techniques. Through the web application is then possible to watch live stream and join to discussion or voting created by the administrator of the session. The last part of research involves development of the mobile application for devices equipped with operating system Android and iOS. Thus allowing citizens to watch live stream, join discussion and vote.

The first step when designing the mobile applications was selection of proper technology. Java programming language with Android SDK development environment Android Studio were selected for development of the application. In case of iOS application, the language Swift and IDE Xcode was chosen. Subsequently, based on the prior analysis, one or more communication technologies were chosen and selected based on the type of transmitted data, necessity of persistent connections and type of client. The final application has three main functionalities, specifically live stream playback, discussion and voting. RTMP streaming protocol was used for live streaming. WebSocket was chosen to enable discussion and voting, due to its possibility of keeping connection opened and receive data form server without requesting it. REST was chosen as more appropriate solution for sending discussion messages and voting, due to its necessity to secure this communication. Reasons for choosing this combination of technologies was discussed earlier. The last step was graphical design of application for both platforms. The main goal was to follow conventional design for particular operating system and use the native components or user interface. Design of Android application so contains single main screen divided into two sections, video section and section with TabLayout and container for two fragments (discussion and voting). On the other side, iOS application design uses common navigation bar with four tabs, so every functionality has own screen.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

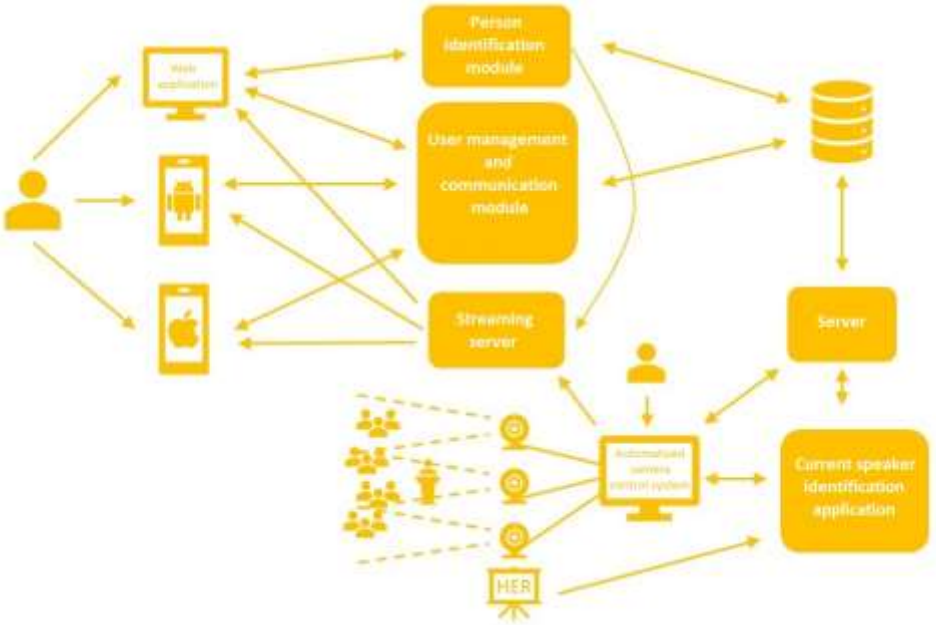

Figure 1. Model of system for government of city Poprad

Implementation was adapted considering the requirement of having two types of users. Viewers, or not logged users, can only watch live stream, and read discussion and voting. Second type of users are logged users, who can also send messages to discussion and vote in voting. User interface had to be implemented, since two types of users are expected, and is adapted to the conditions. For example, discussion messages are display differently for both types of users. Logged users have posted messages colored differently to the other messages. Also, different options are offered for users on settings screen. Viewers can only sign in or sign up but the logged users can edit their profile, change their password or log out from application. Making the implementation of applications is easier, since several third-party libraries were used. For Android application libraries Vitamio, Retrofit, Jackson, Butter Knife and Apache were used. Implementation of iOS application utilized RestKit and SwiftWebSocket libraries.

Implemented applications were experimentally tested on real devices and two emulator devices, the subject of tests were the main functions of applications. Prior to testing the live stream playback, creating of testing stream, was necessary. Software called Adobe Flash Media Live Encoder was used for such purpose, this tool can transmit video captured by laptop camera and send it to Wowza streaming server. This software tool can be used to set parameters of captured video, such as format or video and audio quality. Point of interest in testing the live streaming was to find out if different size of video and different networks have effect on delay of live streaming. Tested networks were Wi-Fi, LTE and 3G using Slovak Telekom mobile network, tested sizes of video were 320x240, 640x480 and 1280x720. All the different combinations of network and video size were tested and results of testing can be found in Table 1.

Table 1. Effect of network type and video size on live streaming delay

Network type	Video size	Delay
Wi-Fi	320x240	4.453s
Wi-Fi	640x480	4.451s
Wi-Fi	1280x720	6.151s
LTE	320x240	3.700s
LTE	640x480	3.901s
LTE	1280x720	6.303s
3G	320x240	4.164s
3G	640x480	4.221s
3G	1280x720	6.750s

The next two tests were analogous. The reliability of implementation and utilized technologies by sending messages to discussion were tested. Further it was checked whether the other devices received them. Special script

of code was written for testing purposes, script sends the message to discussion every five seconds, in total 30 messages were sent. All the messages were successfully sent, and received as well. Voting was tested in same way.

CONCLUSION

The purpose of this research was to find the advanced solution for communication between city government and its citizens using available technologies. Subsequently, technologies for client-server communication deployable for this purpose were analyzed. Existing solutions for enhancing the government-citizen interaction were analyzed and evaluated. Another point of the analysis was dedicated to streaming, streaming protocols and security of streaming server Wowza Media Systems. All the data collected in analysis were subsequently used in proposal of the mobile solution that is part of the larger research. Research was aimed for the government of city Poprad. Implemented mobile application and its main functionalities were experimentally tested and prove their reliability and usability.

ACKNOWLEDGEMENTS

Paper is the result of the Project implementation: Competency Centre for Knowledge technologies applied in Innovation of Production Systems in Industry and Services, ITMS: 26220220155, supported by the Research & Development Operational Programme funded by the ERDF.

REFERENCES

[1] CURBERA, F. et al. Unraveling the Web Services Web: An Introduction to SOAP, WSDL, and UDDI. In IEEE Internet Computing, ISSN 10897801, 2002, vol. 6, no. 2, p. 86-93.
[2] COX, J. SOAP vs. REST For Mobile Services. 2015. Available on internet: https://www.captechconsulting.com/blogs/soap-vs-rest-for-mobile-services.
[3] DENIS, A. Will WebSocket survive HTTP/2?. 2016. Available on internet: https://www.infoq.com/articles/websocket-and-http2-coexist..
[4] FETTE, I. - MELNIKOV, A. The WebSocket Protocol. In Internet Engineering Task Force, ISSN 2070-1721, 2011. Available on internet: https://tools.ietf.org/html/rfc6455.
[5] MCCLURE, D. L. Statement of David L. McClure, U.S. General Accounting Office, before the Subcommittee on Government Management, Information and Technology, Committee on Government Reform, House of Representatives 2000. Available on internet: http://www.gao.gov
[6] LEE, J. W. Developing Fully Functional e-Government: A Four Stage Model. In Entrue Journal of Information Technology, 2003. Chapter 2.1, p. 45 - 54.
[7] COSTELLO, S. Internet Streaming: What It Is and How It Works 2016. Available on internet: https://www.lifewire.com/internet-streaming-how-itworks-1999513.
[8] SYME, M. - GOLDIE, P. Understanding Application Layer Protocols In Optimizing Network Performance with Content Switching: Server, Firewall, and Cache Load Balancing, Prentice Hall Professional, 2004.
[9] ŠIMON, E. Mobilná aplikácia pre príjem TV staníc. Bakalárska práca, Technická Univerzita v Košiciach, Košice (Slovensko), 2013. Kapitola 3, Streamovanie videa a zvuku na mobilné platformy, p. 32.
[10] ČANDRLIĆ, G. RTMP – Real Time Messaging Protocol Explained In CDN, 2014. Available on internet: http://www.globaldots.com/rtmp-realtime-messaging-protocol-explained-2/.
[11] PAVLOV, J. Riešenie pre pokročilú komunikáciu samospráv s občanmi. Diplomová práca, Technická Univerzita v Košiciach, Košice (Slovensko), 2017.
[12] SIVÝ, M. Automatizovaný systém pre riadenie viacerých kamier s ohľadom na aktívneho rečníka. Diplomová práca, Technická Univerzita v Košiciach, Košice (Slovensko), 2017.
[13] ŠTEFAN, D. IP streamingové riešenie s prvkami identifikácie objektov v obraze. Diplomová práca, Technická Univerzita v Košiciach, Košice (Slovensko), 2017.

CITE AN ARTICLE

Pavlov, J., & Michalko, M. (2017). ADVANCED COMMUNICATION SOLUTION FOR COMMUNICATION OF CITY GOVERNMENTS TO ITS CITIZIENS. *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*, *6*(9), 1-6. Retrieved September 4, 2017.