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Service Oriented Architecture for Remote Control of Mobile Devices

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Abstract: ***Mobile devices and applications are available in all industries and provide a solution to many of the agile automation requirements. It also provides a means to improve the big potential of mobility in Human Machine Interface and Information and Control Systems (ICS). In this paper we are integrating the benefits of Service Oriented Architecture (SOA) in mobile applications and devices. Service Oriented Architecture is a progressive and evolutionary technological advancement which happened in application integration and mobile space. In this paper we will look at the Service Oriented Architecture implementation of controlling the camera on a mobile device and evaluate the benefits compared to other traditional approaches in terms of network utilization and efficiency. It also provides an extension point and generalization for all remote applications using a service oriented approach.***

Keywords: Service Oriented Architecture, Remote Control, Mobility, Web Services.

1. Introduction

SOA is an evolutionary step in enterprise application integration providing automation capabilities to a very large extent by integrating disparate existing systems with newer applications and technologies. SOA acts as a bridge between two different information systems. SOA is based on an agile mode of development and deployment, hence changes to the applications and processes will not impact the smooth functioning of the system. It is typically an architectural pattern in which components provide loosely integrated suite of services to other components over a communication medium. It uses a wide variety of implementation platforms. Mobile devices also operate on different platforms and constantly changing technologies. We look at extending the application benefits of SOA mainly the collaboration functionality in remote controlling of mobile devices [1].

2. Literature Survey

There are different Supervisory Control and Data Acquisition/Human Machine Interface (SCADA/HMI) Systems which help humans to control remote processes and helps in decision making. For SCADA/HMI systems industry still does not have an efficient and easily adaptable implementation platform [1]. We can take a look at the advantages and disadvantages of the possible implementations to reach a possible remote control option which has features like less network overload, integrate disparate mobile platforms, and allows data visualization and correction.

- HMI server and web browser provides remote access through web browser on mobile devices. This option allows visualized data, but it does support interaction with data [2]. In case of network failure HMI will be disabled.
- SCADA server and web browser is another available option which provides remote access via web browser and allows remote confirmation and correction with mobile clients [2]. This option has reported problem with modular third-party collaboration in ICS and it is sensitive to network failures.
- SCADA server and client mobile devices support remote accessing the server using mobile application. Mobile phone applications accelerate to and fro communication from the servers. In certain aspects like more computing processes running on client side and network failure tolerance [2]. It can work in offline mode but during network failure HMI system will be disabled.
- Yuen Xing and Ercang Yao [3] studies the implementation of SOA in remote collaborative experiments which provides a new platform for research systems for scientist across the globe to collaborate their studies and research.
- T. Lojka et al. [1] describes the benefits of SOA in Information Control Systems in their research published in International Symposium on Applied Machine Intelligence and Informatics.

3. Problem Definition and Motivation Behind using SOA

High level languages like java and internet protocol is in use for interacting with heterogeneous applications in various industries and business domains. The drawback is that most of them do not provide a homogenous programming platform [4]. The idea behind using SOA is to extend the current available options by providing a java centric programming platform for interacting with mobile devices.

SOA is based on loose coupling of services or functions with the underlying operating system and other technologies. The implementation is based on designing separate functions and making them available over a network for users to avail the required functionality. The communication between the users and these services defined on the application server happen through a well-defined format. Below are the key benefits [5] in using SOA in remote control and collaboration:

- Low development and implementation cost
- Flexible and reusable
- Interoperability
- Compliance to industry standards
- Loosely coupled architecture which allows mobile devices running on different platforms to use the defined services
- Capability to introduce changes rapidly

This extending step for using SOA for remote control of mobile devices brings in the capability to introduce new automation and auto configuration features.

4. Implementation methodology and guidelines

The following guiding principles define the ground rules for development, maintenance and usage of SOA [5]:

- Service loose coupling – minimize the dependency between different modules and components
- Service abstraction – hide the logic from the outside world
- Service reusability
- Service location transparency – ability of a user to invoke the service regardless of the actual location in the network
- Minimize network utilization and maximize efficiency

This implementation of remote controlling the camera on a mobile device is through web services approach. Web services is an SOA implementation methodology which makes services or functionality accessible over standard internet protocols independent of programming languages and underlying platform. This gives another advantage of implementing the solution for different mobile devices. (Figure 1) [1]

The high level architecture include technological tier, database, server side implementation and a mobile client. The technological tier is realized by the service oriented architecture for communicating with the device.

The mobile client application gets the handle to the basic setups to access and operate the camera on the mobile device. This application can be written in any of the programming languages which are suitable for the mobile device and operating system. In our implementation we have used android NDK for developing the client application.

Services which request for data from the camera are based on event based streaming rather than continuous streaming of bytes. This ensures minimal network usage. All data transferred is stored securely in the database. The connection details of the client which request for the service is stored securely in the database for reconstituting the events recorded. The data will be automatically refreshed and inserted with timestamp.

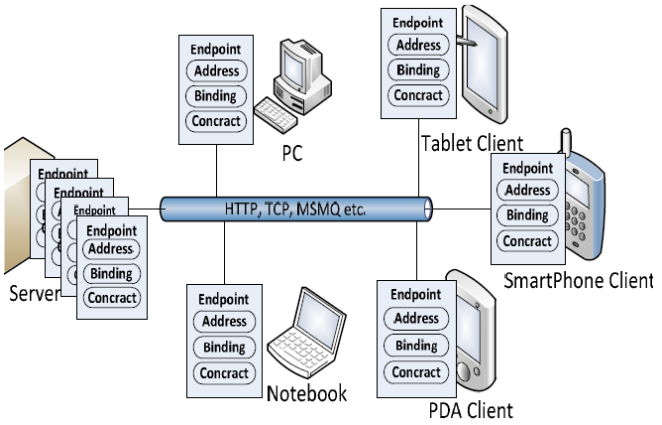

Figure 1: Global architecture of SOA implementation

4.1 Server Architecture

The services will be provided on defined end points by the server. Based on the request name, input and output parameters the requests will be processed with the corresponding services. Once the connection is established, server will automatically retrieve the data captured from the camera at a defined period or whenever there is a new event. The server also has a display which can utilize the data captured from the camera through display and collection.

4.2 Client Architecture

The implementation is based on a mobile android application which can communicate with the server through defined services. The client application has a logic and control tier for capturing the requested data and transmitting them as events based on the request from server. The client is easily configurable to adopt the server communication. It makes a binding connection to the server once the initial request from server is accepted by the client. The SOA remote terminal control unit module which is part of the client implementation will collect raw data and then derive useful data before transmission.

4.3 Communication using SOA

Open telemetry protocols which can be implemented using SOA provides a uniform approach as well as key benefit in optimization of both data gathering and transmission. Transforming and transmitting the collected data into useful information occurs through the control logic in the remote terminal control unit, by detection of interesting changes in the visual images that are recorded using the camera.

4.4 Algorithm to capture and transmit the data as events:

This is adapted from multiple telemetry protocols. System capture interesting changes in the data as events following the below steps:

Step 1: Define the end points in the network.
Step 2: Bind the end points in the control center on server.
Step 3: Capture the current state, data, time, set deviation parameters, expected frequency of change.
Step 4: Collaborate with the device using the below criteria

set for capturing the events from the device. The services defined allows to change these parameters based on the requirements and situations to be captured.

- A point state change occurs
- A change in data quality (e.g.:- A value gone out of range)
- A value has deviated more than a specific amount since the last time the value was reported.
- A value expected to be changed but has not changed.
- A value changing rapidly.

A client always records the events (interesting data changes) along with the timestamp at which the change occurred to reconstitute the complete scenario.

Figure 2: System Architecture

5. Results and Discussion

A challenge in remote machine control is the broad variance in potential communication network solutions. A uniform approach to sending data across this broad variance of remote network types is preferred over individual solutions for different technologies. This is very important for the long term viability of remote device controlling, collaborating and monitoring as technologies keep changing and evolve faster. The approach also needs to be highly scalable to suit system sizes from dozens to thousands of mobile devices depending on the requirements.

The above approach discussed in this paper optimizes bandwidth through efficient representation of information, capturing and transmitting data as events. The control center receiving the information can reconstitute the data accurately, independent of how frequently the data was transmitted or if the communication link was inoperable for a period of time. This provides significant data accuracy, optimizing the availability requirements of the remote communication network without compromising data integrity.

6. Conclusion and Future Scope

The proposed architecture to remote control a mobile camera can be extended to effectively collaborate with a remote machine. It provides a path to extend the research in integrating SOA with HMI. When data is provided by the remote device in the form of events, significant bandwidth and response time gains can be made. Remote machine control is increasingly adopted in various domains with different end user requirements. Convenient and reliable ways of remote collaboration and control needs more research and experimentation. The architecture proposed in this paper leads to building easy collaboration with remote devices in an efficient network utilization manner. Intelligent client application which can easily convert the data captured into useful information based on the information already captured is an area for further research and study. This will reduce the server side load on reconstructing the images captured.

References

[1] T. Lojka, M. Miskuf, I. Zolotova “Service oriented architecture for remote machine control in ICS”, SAMI 2014, IEEE 12th International Symposium on Applied Machine Intelligence and Informatics, January 23-25, 2014, Herl’any, Slovakia
[2] Fabio Terezinho, “Remote access, any time, any place”, ISA InTech, September/October 2012.
[3] Yuen Xing, Ercang Yao Remote Collaborative Experiments Based on Service-Oriented Architecture (SOA) 2010 2nd International Conference on Signal Processing Systems (ICSPS)
[4] Pablo Basanta-Val and Marisol Garca-Valls, A Distributed Real-Time Java-Centric Architecture for Industrial Systems, IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS, VOL. 10, NO. 1, FEBRUARY 2014
[5] https://en.wikipedia.org/wiki/Service-oriented_architecture
[6] Tai-hoon Kim., “SCADA Architecture with Mobile Remote Components”, WSEAS Transactions on Systems and Control, Issue 8, Volume 5, pp. 611 – 622, August 2010.
[7] Zolotova, I., Lacinak, L., Lojka, T., "Architecture for a universal mobile communication module," Applied Machine Intelligence and Informatics (SAMI), 2013 IEEE 11th International Symposium on , pp.61-64, Jan. 31 2013-Feb. 2 2013.
[8] M.-T. Schmidt, B. Hutchison, P. Lambros, R. Phippen. The Enterprise Service Bus: Making service-oriented architecture real.IBM report, 2014.