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## DEVELOPMENT OF CROSS-PLATFORM UTILITY FOR THE DBA USING A LIBRARY FOR WORKING WITH BOTS

*Abstract: This article considers the basic principles of building cross-platform utility for monitoring of the database state. The information about collection of database statistics and development of the library for implementing of bots on platforms of various messengers is analyzed.*

**Key words:** Databases, Data systems.

**Language:** English

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### 1 Introduction

At the present time there are many problems faced by administrators of databases (DBs) and database management systems (DBMS). One of the main problems is the problem of data security. For DBMS, which store and manage the data of enterprises, the task of ensuring safety is paramount.

By conducting a set of measures aimed at data protection, database administrators (DBAs) try to protect them as much as possible and to limit the scope of ordinary users, but for various reasons they can still create a wide variety of issues.

The article discusses the creation of a database administrator utility, based on a messaging bot, the main task of which is to notify the administrator about attempts to connect to the database and change it.

### 2 Motivation

Any productional database is constantly changing, both in terms of internal state (addition and modification of data), and in terms of external conditions associated, for example, with the development of software to meet new requirements. The qualitative work of the database is critically dependent on correct and timely diagnosis. It is important not only to know all the information about

the system, but also to learn about the changes as quickly as possible. You must constantly monitor the operation of the database to ensure that it is working correctly and it is not suspended by running a complex task that reduces performance. The database administrator should receive notifications about:

- How the database currently works - in general and in comparison, with other periods;
- Which requests are most heavily burdened by the server (CPU, memory, storage systems);
- How many requests and which ones have been finished, at what time and by which users
- etc.

### 3 Implementation

It is proposed to create a bot based on instant messenger bot library, which will allow the DBA to be constantly able to check the status of the system and be aware of its changes due to a set of commands and push notifications. This solution seems to be the most correct, since manual testing takes a lot of time, while notification of emergency situations (using push technology [1]) and the ability to quickly learn about operations can significantly reduce time costs. It should also be noted that a lot of organizations use bots, and today they are available on any platform, whether it's a desktop computer, a mobile phone or a web browser.



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As messengers for the implementation of the utility, were selected:

- Slack, the most popular corporate messenger; [2]
- Facebook Messenger, the most popular messenger around the world; [3]
- Telegram, the best platform for creating bots [4].

Since the implementation of such functionality for different DBMS is a laborious process, within this article it was decided to implement the support of only one of them – PostgreSQL, as this DBMS is free, advanced, open and rapidly gaining popularity, replacing competitors (including powerful commercial DBMSs such as Oracle, MS SQL Server, DB2, etc.). [5; 6]

The Bot API consists of several modules:

- Bot Library - a library for interacting with various messengers (Facebook Messenger, Telegram, Slack);

- Pg Log Module - module for working with PostgreSQL log-files. It takes information about the actions that occur with the database from the file, analyzes it for error messages to issue a notification to the administrator as soon as possible about what is happening;

- Pg Stats Module - a module for working with statistics, which provides PostgreSQL using the pg\_stat views. This module makes queries to the extensions pg\_stat\_activity and pg\_stat\_statements and sends data to end users using the Bot Library.

The component scheme of the program is shown in Fig.1.

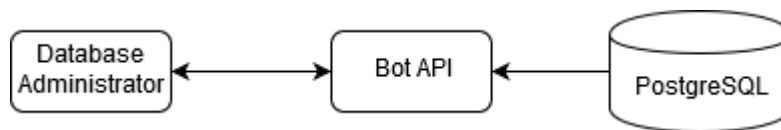


Fig. 1. Component scheme

### 3.1 Collecting database statistics

In PostgreSQL DBMS, there are several ways to collect information about the database [7], which we will use to send to the administrator through the bot. The main source of this information is the pg\_stat\_statements extension. It is a set of procedures for obtaining various statistics about the queries that the server processes. In order to obtain and process statistics, this module uses a pg\_stat\_statements view and auxiliary functions Pg\_stat\_statements\_reset and pg\_stat\_statements. Based on the obtained statistics the administrator can perform request monitoring — look at the statistics

on time. This is extremely useful for finding the causes of various problems and for understanding what is happening on the database server in general.

While using pg\_stat\_statements extension the administrator receives the grouped statistics not for each query but for a group of queries identical in terms of PostgreSQL. Besides query information with help of this set of views you can learn about the number and time of reading and writing blocks on the disk (Table 1 [8]). All counters keep statistics from the start or from the moment they are reset by the database administrator.

Table 1.

Variables that contain information about the database

Name	Description
userid and dbid	OID of user and database who executed the statement
queryid	Internal hash code, computed from the statement's parse tree
query	Text of a representative statement
calls	Number of times executed
total_time	Total time spent in the statement, in milliseconds
min_time, max_time and mean_time	Minimum, maximum and mean time spent in the statement, in milliseconds
stddev_time	Population standard deviation of time spent in the statement, in milliseconds
rows	Total number of rows retrieved or affected by the statement
shared_blks_hit, shared_blks_read, shared_blks_dirtied and	Total number of shared block cache, read, dirtied and written hits by the statement

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shared blks written	
local_blks_hit, local_blks_read, local_blks_dirtied and local blks written	Total number of local block cache, read, dirtied and written hits by the statement
temp_blks_read and temp blks written	Total number of temp blocks read and written by the statement
blk_read_time and blk_write_time	Total time the statement spent reading and writing blocks, in milliseconds

It should be mentioned that only completed queries fall in `pg_stat_statements`. That is, if the query runs for a long time and is still not finished, it will be visible only in the `pg_stat_activity` view.

Also, information about database users and their transactions can be obtained from PostgreSQL

log-files (Table 2 [9]). In order to convert information and output it to user, log-files should be searched to find queries that are of interest to the administrator (user of the utility).

**Table 2.**

### Log-messages PostgreSQL

Severity	Usage
DEBUG1..DEBUG5	Provides successively-more-detailed information for use by developers.
INFO	Provides information implicitly requested by the user, e.g., output from <code>VACUUM VERBOSE</code> .
NOTICE	Provides information that might be helpful to users, e.g., notice of truncation of long identifiers.
WARNING	Provides warnings of likely problems, e.g., <code>COMMIT</code> outside a transaction block.
ERROR	Reports an error that caused the current command to abort.
LOG	Reports information of interest to administrators, e.g., checkpoint activity.
FATAL	Reports an error that caused the current session to abort.
PANIC	Reports an error that caused all database sessions to abort.

### 3.2 Development of the Bot Library module

At the core of the library programming for working with bots is the understanding that the web server installs the so-called webhooks – the addresses to which the messenger server will send information about events in the chat with the users. In fact, the server receives a message and returns the response that the developer has written to user. Therefore, it is possible to consider that the most part of the bot’s software interface is about to receive and send information in JSON format to special addresses on the server of the messenger.

To develop the module, it was decided to use the Java language because it is one of the most popular programming languages [10] and its library standard has everything necessary to implement the interaction with messengers [11]. Using only standard classes and methods involves the need to write a lot of repetitive low-level code, so it is more convenient to use libraries that simplify interaction with messengers. In order to do this a set of libraries which is the part of the Bot library was implemented.

To ensure that the libraries that were written can be used in other projects you should use the

framework to automate the assembly (such as Maven or Gradle) to connect external dependencies from repositories such as Maven Repository [12]. That is why this approach was used to conveniently connect the implemented library.

Once the libraries were created and built, the main task was to merge them into the Bot Library in order to developer could immediately transmit his bot to multiple platforms [11].

### 3.3 Analysis and testing

On average, to get information about the status of the database, the administrator is forced to: resort to either using a paid software package, or manually to view log-files and make requests for views and packages.

Due to the implemented solution, many administrators can have a significant increase in productivity.

To check how utility is running, there was created a database that stores data to execute test queries for receiving notifications. It was decided to use Open Server as a server and the software supplied with it, which provides a graphical interface



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to operate with database – PgAdmin that improves the process of setting up the environment for development. The number of transactions were executed by the premade users, also some errors were emulated for checking push notifications. As an illustration, in Fig. 2 you can see the administrator's

query to search executed "select" statements and the result of this search on different platforms.

Therefore, due to receiving notifications or requests to the bot the administrator can have up-to-date information about the status of the database, users, executed scripts, errors, etc.

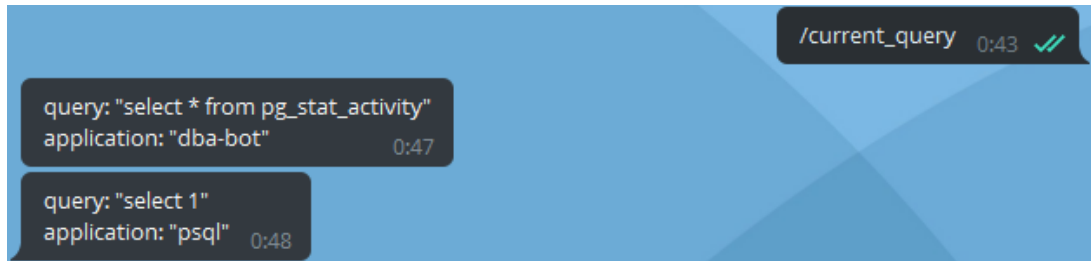


Fig. 2. Checking completed database requests on Slack platforms.

## 4 Conclusion

Based on methods of construction that were offered in article the utility allows DBA to quickly, easily search information about the status of the database, usage statistics, and via push notifications instantly receive information about critical situations. The architecture offered above has an important advantage – its cross-platform that gives you a

possibility to use the implemented system on a wide range of devices (clients on the desktop computer, the web browser, the mobile phone).

The implemented library allows users to create basis bots of any content on several platforms at once that increases development speed.

In the future, the authors plan is to improve the created products by adding new messengers, graphs of impact on server load and other features.

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