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Research paper

Implementation of mobile APP service in an electronic tax invoice

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Abstract

Background/Objectives: This study is designed to carry out effective work such as electronic tax invoice issuing,transfer and retrieval for National Tax Administration, tax invoice checking in sales and purchase through smartphone with no regard to time and place according to the development of issuing in electronic tax invoice based on smartphone mobile application against electronic tax invoice based on existing Web.
Methods/Statistical analysis: Data analysis of existing electronic tax invoice and database analysis of electronic tax bill based on existing Web for the purpose of application development in iphone and Android based phone.
FindingsSmartphone based functions of how to write or issue or check a tax invoice as well as supporting customer are implemented in this study in order for the target of design and building application in smartphone for Web based electronic tax invoice through analysis of database in existing Web based electronic tax invoice.
Improvements/Applications: Services that can deliver electronic tax invoice issuingmore quickly and rapidly to a lot of users having restrictions in time and place who are related in wholesale and retail dealers, distribution dealers, and fording agent are able to provide through application of electronic tax invoice issuing based on smartphone which is developed in this study.

Keywords: *Electronic Tax Invoice; RSA; AES; Android; Mobile.*

1. Introduction

An electronic tax invoice is an implemented system not only to save compliance cost of taxation according to use of paper tax invoice due to increasing use of Internet but also to improve transparency in business transaction. It replaces the conventional method of forwarding registration mail for a handwritten tax invoice or delivering it in the person in charge with new service method of that each business is supposed to issue and report a tax invoice for National Tax Administration in the way of electronic method such as using Internet to write or to report or to receive a tax invoice [1], [2]. There is the cost in terms of purchasing the paper forms and seal, dispatching cost, and storage place expense for tax invoice papers in case of a handwritten tax invoice system. On the other hand, an electronic tax invoice makes it not only hard to issue a false tax invoice that is illegally intended purpose in transactions between companies for the purpose of increasing transaction transparency but also simplified management work and increasing efficiency due to the record storage in the National Tax Administration without the loss of issued tax invoices[3,4]. Service capable of issuing electronic tax invoice based on smartphone in this study is able to be provided with no bounds on time and place. A larger data of application is also encrypted by a high speed of AES and AES private key with low capacities is implemented to encrypt by highly secured RSA[5,6].

2. Implementation of electronic tax invoice based mobile APP

2.1. Database analysis of existing electronic tax invoice

Properties and relation of electronic tax invoice based on smartphone is to be defined according to not only reference of database in electronic tax invoice based on existing Web but also identification of link relation. Data analysis to implement mobile type for electronic tax invoice based on existing Web is accomplished and functionality as well as items such as log-in, existing settings, main screen, details screen, administrator functions, writing tax invoice, issuing, and supporting customer is designed to interlock with database [7], [8]. Analysis screen of database in electronic tax invoice is shown in Figure1.

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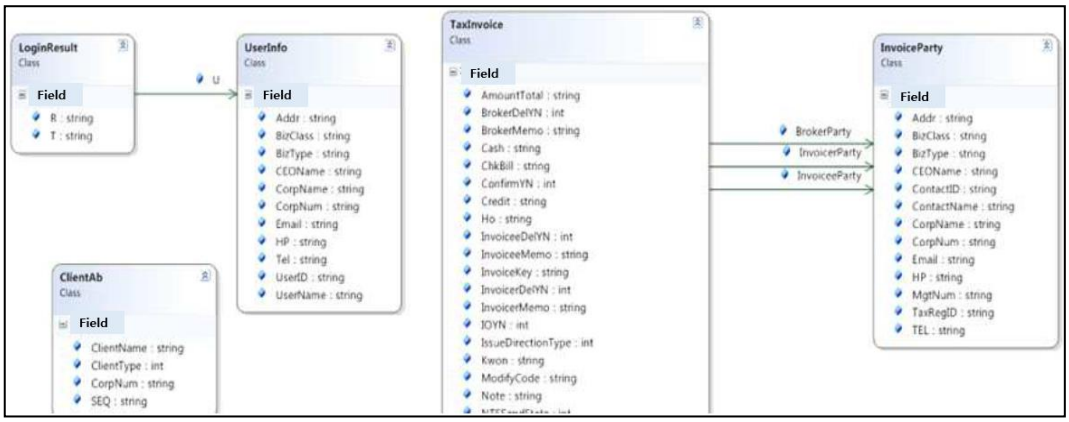


Fig. 1: Database Analysis of Electronic Tax Invoice.

2.2. Encryption protocol design and development of applied module

Information of iphone and Android phone through 3G, 4G, and WiFi communicating with an operating server is to be transferred mutually. Threats such as leakage of personal information as well as certificate information exist especially in case of WiFi communication without security settings. Leakage of personal information and business information according to mobile convenience and supporting mobile office would do an even greater threat, including security vulnerability of Android OS due to open platform, malicious virus making and opportunity enhancement of its circulation due to application distribution through app store, various route of infection. Therefore, Security technology for smartphone is to be required. Diverse technology in hardware and software has surfaced recently. The encryption techniques have appeared to make use of it [9].

Design of encryption protocol and development of applicable module is necessary in this study. To do this, typical open key algorithms as RSA (Rivest Shamir Adleman) and AES (Advanced Encryption Standard) are used. RSA with a low speed as an open keyencryption algorithm has a highly secure while AES with a high speed as a secret key encryption algorithm has lower security. Encryption of application data with relatively high volume is done by high speed AES while encryption of AES secret key with relatively low volume is done by high security RSA. Encryption module of server is to be performed for this. Cryptogram and AES key are supposed to transmit in response to client's request after finishing encryption [10].

Encryption module based on existing AES method and RSA method is designed in this study. In order to certificate communication between smartphone and server as a characteristic of electronic tax invoice, encryption protocol utilizing token method is designed. Sequence diagram of the authentication token that is generated by the server is shown in Figure2.

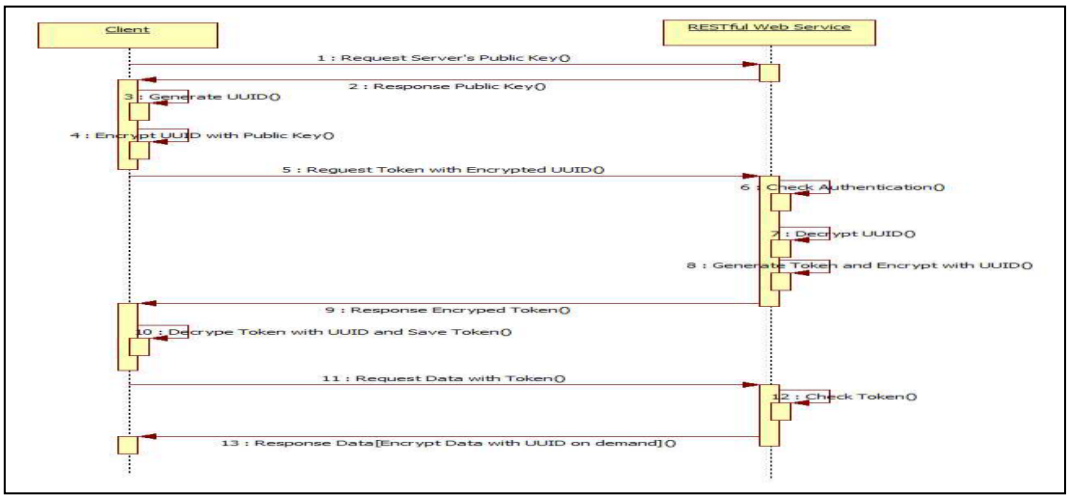


Fig. 2: Sequence Diagram of the Authentication Token That Is Generated.

2.3. Interface development considering user convenience

Mobile application is not simply express an existing operated website but utilize the place of communication between human and system through mobile devices. To do this, practical use of application, ease of system use, and efficiency of system are considered to implement. Interface design is a process to improve convenience and efficiency for making frame that contains information in the screen. Achievement of interaction between provided information and users is designed to implement. The application of electronic tax invoice for smartphone is designed to maximize convenience, simplicity, consistency, and visibility.

2.4. Performance of compatibility test for each version/each terminal in android

The problem arises when Android app is working normally in one Android terminal while it is not working in other terminal. The reason for this is not only to release frequent update of OS in Google due to the variety of Android platform but to load specialized function and UI for differentiation of terminal manufacturer. Android CTS (Compatibility Text Suite) is a test tool to confirm not only if the existence of API required in Android standard SDK but compatibility in Android device. As a way of compatibility test method through test framework of Android compatibility, study on how to cope with fragmentation problem of Android is

implemented. Android compatibility test through the related technical cooperation is conducted as shown in Figure 3.

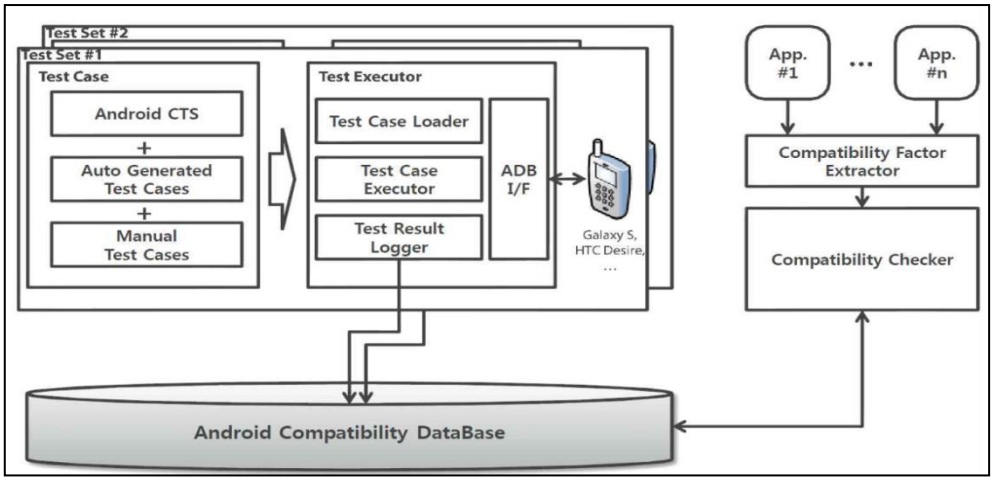


Fig. 3: Example of Compatibility Test Framework in Android.

Speed measurement module of interior app in Android environment is shown in Figure4 and speed measurement of ISO is shown in Figure5.

Android

```
Calendar calendar = Calendar.getInstance();
String StartDt = "Start Date : "+calendar.getTime().toString()+"\r\n";

Message msg = null;
BarobillApp bba = (BarobillApp)getApplicationContext();
WebService ws = new WebService();

String result = ws.CallDocTemp(bba.getServer_token(), bba.getUUID(), ws_t1);
if(result.equals("")||result==null){
    msg = handler.obtainMessage(0);
} else {
    String[] arrResult = result.split("\\|");
    resultCode = arrResult[0];
    resultValue = arrResult[1];
    if(resultCode.equals("FAIL")){

        getErrString = ws.GetErrString(bba.getServer_token(), bba.getUUID(), resultValue);
        msg = handler.obtainMessage(10);
    } else {
        if(type.equals("TEMP")){
            msg = handler.obtainMessage(11);
        } else if(type.equals("ISSUE")){
            msg = handler.obtainMessage(12);
        } else if(type.equals("PREISSUE")){
            msg = handler.obtainMessage(13);
        } else if(type.equals("REQISSUE")){
            msg = handler.obtainMessage(14);
        }
    }
}
handler.sendMessage(msg);
String EndDt = "End Date : "+calendar.getTime().toString()+"\r\n\r\n";
try{
    File file = new File("/sdcard/download/request_time_log.txt");
    OutputStream os = new FileOutputStream(file);
    os.write(StartDt.getBytes());
    os.write(EndDt.getBytes());
    os.close();
} catch(Exception e){
```

Fig. 4: Speed Measurement Module of the Inside App in Android Environment.

iOS

```
-(void)DoAction
{
    [self.view endEditing:YES];

    // start log
    NSDate *now = [[NSDate alloc] init];
    NSDateFormatter *dateFormat = [[NSDateFormatter alloc] init];
    [dateFormat setDateFormat:@"yyyy-MM-dd"];
    NSDateFormatter *timeFormat = [[NSDateFormatter alloc] init];
    [timeFormat setDateFormat:@"HH:mm:ss"];

    NSString *theDate = [dateFormat stringFromDate:now];
    NSString *theTime = [timeFormat stringFromDate:now];
    NSString *startDt = @"start date : ";
    startDt = [startDt stringByAppendingString:theDate];
    startDt = [startDt stringByAppendingString:@" "];
    startDt = [startDt stringByAppendingString:theTime];

    NSLog(@"start : %@", startDt);


    [[DejalKeyboardActivityView activityViewForView:[[UIApplication sharedApplication] keyWindow]
        withLabel:@"연결중..." ] setShowNetworkActivityIndicator:YES];

    NSString* jsonStr = [[NSString alloc] initWithData:[NSJSONSerialization dataWithJSONObject:_taxInvoice
        options:0 error:nil] encoding:NSUTF8StringEncoding];


    //NSLog(jsonStr);

    NSString* uri = [@"/TI.svc/" stringByAppendingString:_IsNew ? @"" : [_taxInvoice
        objectForKey:@"InvoiceKey"]];

    if ( _IsNew && modifyCode != 0) {
        uri = [NSString stringWithFormat:@"/TI.svc/%@/%d", [_orgInvoice objectForKey:@"InvoiceKey"] ,
            modifyCode];
    }


    [[SecurityToken CurrentOne] RequestData:uri PostData:jsonStr withReceiver:self  withIdentifier:_IsNew ?
        @"POSTTAXINVOICE" : @"PUTTAXINVOICE"  method:_IsNew ? @"POST" : @"PUT"  withTimeOut:30
        WithEcryption:YES ];


    // end log
    NSString *theEDate = [dateFormat stringFromDate:now];
    NSString *theETime = [timeFormat stringFromDate:now];
    NSString *endDt = @"start date : ";
    endDt = [endDt stringByAppendingString:theEDate];
    endDt = [endDt stringByAppendingString:@" "];
    endDt = [endDt stringByAppendingString:theETime];

    NSLog(@"start : %@", startDt);
}
```

Fig. 5: Speed Measurement Module of IOS.

Table 1: Response Size and Time According to Application of Compression/Encryption in Restful Web Service

Comparision system	Size	Response time	Remarks
General RESTful web service	308,558 byte	912ms	
HTTP Compression	32,186 byte	132ms	
Encryption> HTTPCompression	38,584 byte	216ms	
Compression >Encryption	33,474 byte	181ms	Proposal system

Table 2: Response Size and Time According to Message Format in Restful Web Service

Message format	Size	Response time	Remarks
JSON	308,558 byte	912ms	
MessagePack	297,157 byte	871ms	
JSON - Compression/ Encryption	33,474 byte	181ms	Proposal system
MessagePack– Compression/ Encryption	31,865 byte	164ms	

The results such as error type, expected result, test data, error occurred function, and file location are possible to look through due to creating XML form. After the errors are corrected through debugging, test process of final compatibility through certification of Google CTS is implemented. Test subject such as general RESTful web service, web service for only HTTP Compression, web service for HTTP Compression after encryption, and encrypted service after compression are measured.
Measured value of response result and time in 1,000 cases of data as the function used for the assessment is shown in Table1, and 2.

3. Conclusion

The object of this study is to design and to build application based on smartphone (Android/iphone) for the purpose of existing electronic tax invoice as known as Baro-bill. According to analysis database of existing electronic tax invoice system based on web, the functions based on smartphone such as tax invoice writing, issuing, checking, and customer support are implemented. In order to maximize user convenience, user interface based on professional advice in multimedia experts is designed and take advantage of this access to develop GUI which is guaranteed consistency, efficiency, visibility, and aesthetics. Application of electronic tax invoice based on Android and iphone is successfully developed according to virtual analysis of user requirement for application usage based on storyboard.
Smartphone service that is able to issue electronic tax invoice can provide for user without any restriction of time and place. High speed AES is to encrypt application data with big capacity while high security RSA is performed to encrypt AES secret key with small capacity.

Acknowledgment

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