

Web Based Remote Exploration and Control System Using Android Mobile Phone

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Abstract— A remote exploration and control system has been developed using web Application, web server, database, GSM network, and Android mobile phone. Web application is used to control remotely an Android mobile phone and electrical devices connected with the mobile phone. Firstly, command is sent from the web Application and saved in database. The Android mobile phone reads the sent command from database and performs predefined procedure to execute the command and hence, generate outcome due to execution of the command. Thus, this system can be used as an exploration and control system because remote mobile phone automatically implements command like capturing picture and upload the captured picture to the server and control electrical devices. Command is implemented to capture picture automatically of the surrounding location and upload it to server. It can also send automatically GPS location of the mobile phone to server's database. So, it can be used to detect the device's geographical location and collateral condition. Hence, it can be used in monitoring as well as in security system. Finally, command is implemented for generating DTMF tone signal on Android phone. A DTMF detection circuit, interfaced with mobile phone, can automatically detect the DTMF tone signal and generates 4 bit digital code output. This digital output code can be utilized to control any electrical device.

Index Terms— mobile based exploration system, web based control system, Android based security system, picture and GPS location acquisition from remote mobile phone.

I. INTRODUCTION

The smart phone can be used in lieu of computer system that can change the computer based measurement, control, security and monitoring system in a brand new way.

Traditional exploration, monitoring, control, and security systems like security cameras, robots, electrical device controllers, operated via wire or wireless transmitter, have small operating range and they need costly RF transmitter to increase operating range. They cannot be implemented on remote place out of their range. GSM network [1] exists in vast area of the earth which can be used as potential operating area for GSM controlled device. Web based applications are to be installed only once but in case of a desktop application, it has to be installed on each and every work-station. Desktop applications are confined to be used from one workstation, but web applications are used through a computer network, so it

can be accessed from the entire world. Only drawback of a web application is the connectivity. In absence or poor internet

can cause performance issues with a web-application. This paper aims at analyzing, proposing different ways to solve all the above problems and implementing a remote exploration and control systems by using Android software stack [2], GSM network, web server and Web application.

This system can be a good alternative to these traditional systems. This system is cost effective comparing with microwave transmitter and receiver as it uses existing EDGE network. It is very compact, easy to build and Its operating range is substantially as vast as Cellular network.

II. RELATED WORKS

There were several implementations in past for remote exploration, control, monitoring and security system. Most of them used PC based Architecture and desktop application as control center. Some implementations adopted GSM technology but they did not use Smartphone. Web based control systems[3-5] are suitable alternative to these. Some implementations used web application as remote control or command center but their Architecture was not efficient. Virtual Networking Computing [6] or VNC system is used in remote control of device. There are a large number of implementations of VNC architecture. Skurski and Swiercz proposed a control system based on VNC for Symbian OS Smartphone.

This paper focuses on the control of Android phones remotely to explore the current location by capturing picture automatically and upload it to web server. Also, retrieve and send the GPS latitude, longitude to database of web server and control of electrical device interfaced with mobile phone via DTMF detection circuit. Android phone was rarely used as exploration, monitoring and control device in past. This paper presents a proposal that covers this area of interest. Due to the lack of initiatives that provide complete remote control architecture oriented to open source platforms, this paper presents a proposal that covers this area. The proposed system is open source, flexible and compact.

III. SYSTEM COMPONENTS

Our complete system has three parts:

A. Client side Web Application

web application is developed as extension in Joomla CMS[7]. It has two parts: client side and server side part. Client side part is visible to user and users interact with it by sending command and receiving the response due to execution of command. The server side part processes request from client side web application and remote android device application. It interacts with database and shows response in client side part of web application.

The system will first determine the logged-in device by executing ajax request to check if there is any logged-in device to web server by the following link http://cuetandroid.com/index.php?option=com_cuetandroid&task=ajax&fnc=checkConnection.

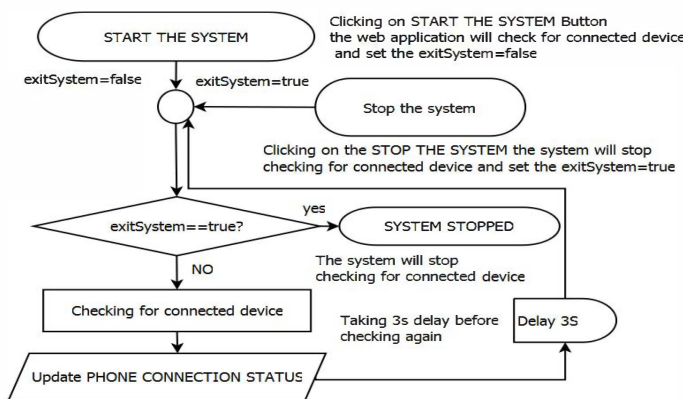


Fig. 1. Block diagram of System start, stop and login process on client side Web.

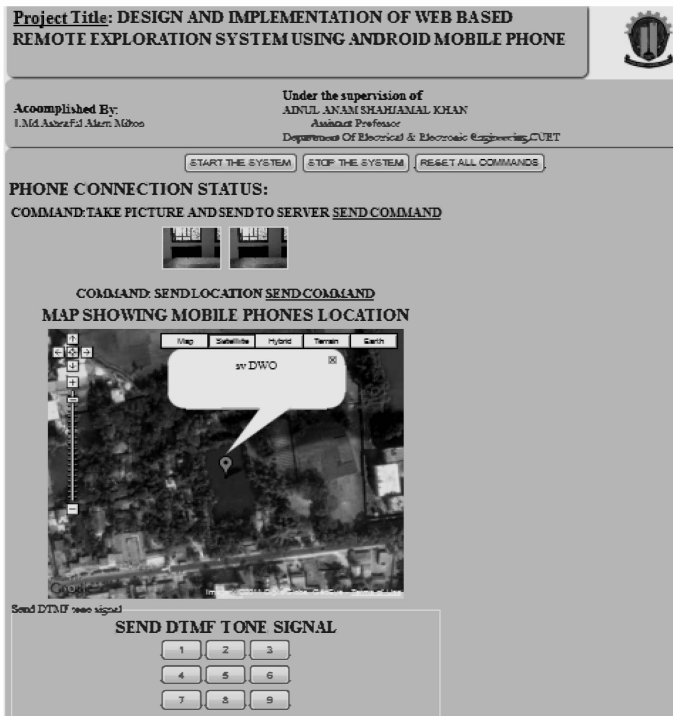


Fig. 2. Home page of our web application from client side.

We used jQuery [8] for AJAX [9] call to retrieve the state of connected device from server database. Joomla CMS, php [10] and MySQL [11] are used to build the web application. HTML is used for web page Structure and CSS for styling the web page. We provided user Interface to start, stop and operate our system graphically. This increases usability and accessibility and any novice user can use and operate our system from web application. We hosted our web application on Linux server and we bought an exclusive domain www.cuetandroid.com for our web application.

B. Server side Web Application

Server side Web Application is developed with php and mysql and It communicates with the database, android device and website. The Serverside web application has two main scripts: ajaxhelper.php and androidTasks.php.

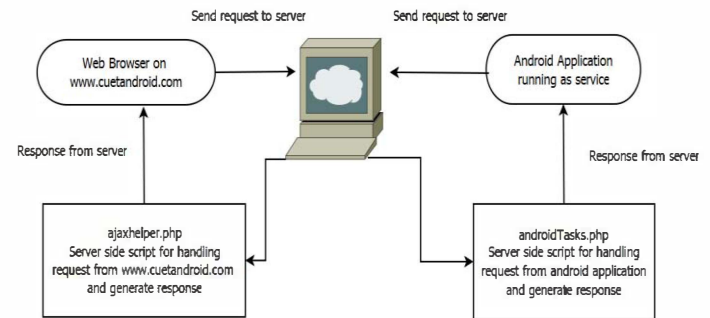


Fig. 3. Server side Web Application.

All requests made to server side web application first go through Controller.php script. It differentiates the request from website and android device and resolve the request to find the actual function to execute from ajaxhelper.php and androidTasks.php and executes the function and creates response. Ajaxhelper.php handles request from client side. It communicates with database after getting command from website and performs operation on database, update database and generate appropriate response after finishing interaction with database. androidTasks.php handles request from android application by communicating with the database and performs operations on the database and generates appropriate response after finishing interaction with database.

C. Android Application

Android SDK [12], eclipse [13] and android plug-in are used for native android application development. Android has couple java core library and it has added additional libraries to provide support for development of the android application.

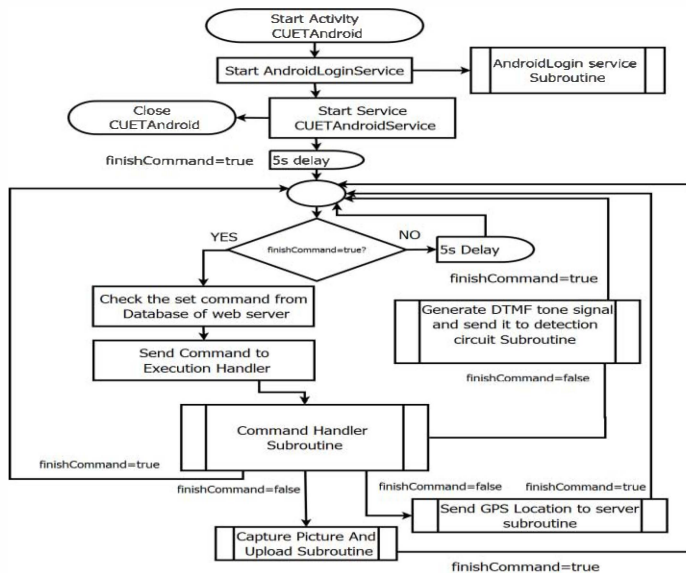


Fig. 4. Block Diagram of Android Application.

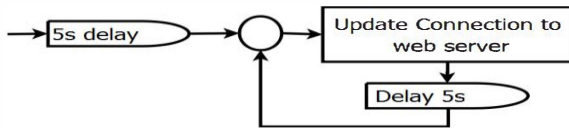


Fig. 5. Android Device login Service.

This service [14] runs on background on android phone. A service is designed to run for long time. This service is started by executing the following code while starting the application. This service keeps the mobile logged in with the server by sending update request after every 5 seconds on the following URL:

http://cuetaandroid.com/index.php?option=com_cuetandroid&task=android&fnc=updateConnection

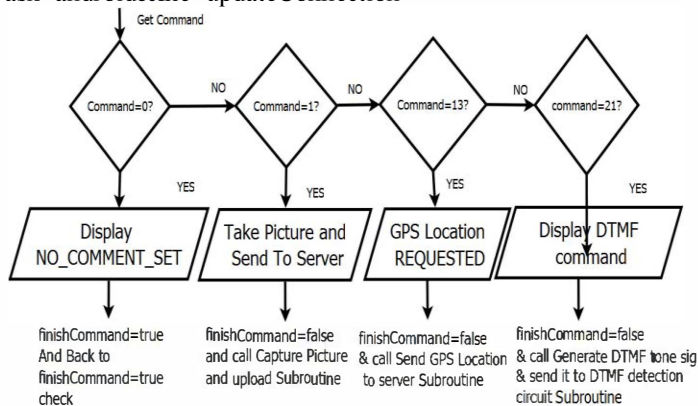


Fig. 6. Android phone Command handler

The obtained command from database is sent to command handler to take appropriate predefined action on android mobile phone.

IV. SYSTEM OPERATION

A. Login Process:

If the remote device is not connected, Phone connection status is "Phone is not connected". Before any command is sent and executed on remote android device, we must know whether the mobile device is online or not.



Fig. 7. Phone is not connected to web server.

The Login software in android is implemented as service and it runs continuously and take a 5s delay after finishing one round and before starting a new round. If the remote device is connected we will see that the Phone connection status is "Phone is connected".



Fig. 8. Phone is connected to web server.

B. COMMANDS

TABLE I
COMMAND TABLE

Id	Command	Executio n	Response	Value
1	1	1	null	CON_TAKE_PIC
4	13	1	22.461692, 91.970991	GET_LOCATION
5	21	1	null	1

Command: 1 mean capture picture and send to server, 13 means send GPS[15] location to server, 21 means play DTMF[16] tone on mobile phone.

Execution: 1 means the command is already executed, 0 means the current command.

Response: It is null for command 1 and 21. But, for command 13 it represents latitude, longitude.

Value: For command 1, its value is CON_TAKE_PIC, For command 13, its value is GET_LOCATION, For command 21, its value is 1-9.

To reset all previous set commands we need to click the RESET ALL COMMANDS button and then the web application will send reset command by logging following URL: http://cuetaandroid.com/index.php?option=com_cuet-android&task=ajax&fnc=resetAllCommand.

If all commands are successfully reset then it will give the following message:

"SUCCESS: ALL_COMMANDS_RESET"

Capturing Picture from mobile phone

We on TAKE PICTURE AND SEND TO SERVER'S belonging SEND COMMAND button to send the command. This command is represented by 1 on web application, database and on the remote android device and its value is CON_TAKE_PIC. We get the message below as response if the sent command is saved to database successfully

“COMMAND SET:
TAKE_PICTURE_SEND_TO_SERVER”

We get the message below as response if the sent command is not saved to database successfully.

“COMMAND NOT SET:

TAKE_PICTURE_SEND_TO_SERVER”

The database table “jos_cuetandroid” is used to store, set and reset the command. We see that the execution of command 1 is 0. So, as soon as the android device reads the command it will execute its predefined actions.

TABLE II
COMMAND TABLE

Id	Command	Execution	Response	Value
1	1	0	null	CON_TAKE_PIC
4	13	1	22.46169205, 91.97099128	GET_LOCATION
5	21	1	null	null

When the android phone gets command to take picture and send to server it displays the command acquisition confirmation on screen by displaying.

“Take Picture and Send To Server”

Then the CaptureImage.java is started and it creates surface to display the view finder of camera. Then it calls the mycamera class to start the display and then capture picture automatically. To store settings and text data we used SharedPreferences[17] of android phone. The picture is then saved to SD card of android mobile and then CaptureImage.java calls the uploadImg(picture_name) for uploading the picture to web server.

androidtasks.php server side scripts handle the request to web server made from android device. When android application uploads the captured picture to server, the uploadpicture() function of the androidtasks.php saves the picture to “pictures” folder of the web server.

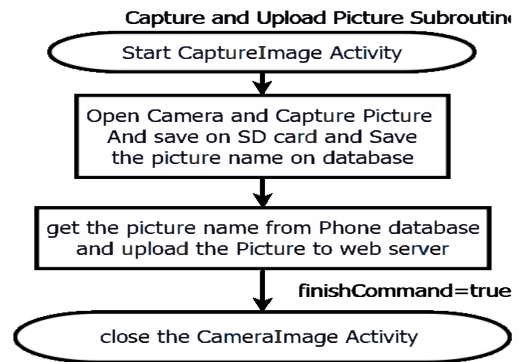


Fig. 9. Capture Picture and Upload Subroutine.

When we browse the homepage of www.cuetandroid.com the web page displays the picture from the “picture” folder of the web server and shows the pictures on the home page.

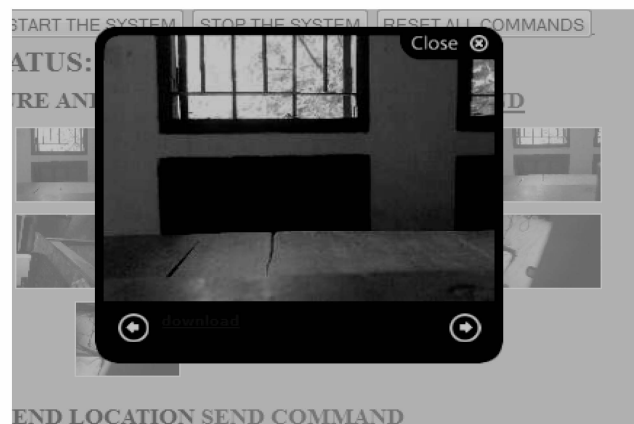


Fig. 10. captured picture shown website.

The picture here is shown in lower resolution. If we click on the picture, the picture is shown in full resolution and is shown in a modal window. We can download the picture by clicking download button shown in full resolution picture.

C. GPS Location from mobile phone

We can send command to send the GPS coordinate of the current location of the mobile phone. We have to click on SEND LOCATION'S belonging SEND COMMAND button to send the GPS location. This command is represented by 13 on web application, database and on the remote android device and its value is GET_LOCATION. We get the message below as the response if the sent command is saved to database successfully:

“COMMAND SET: GET_LOCATION”

We get the response the below message if the sent command is not saved to database successfully:

“COMMAND NOT SET: GET_LOCATION_NOT_SET”

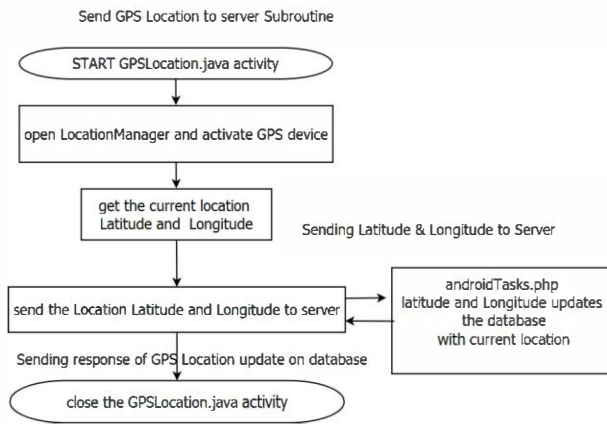


Fig. 11. Get Location subroutine

The database jos_cuetandroid is used to store, set and reset the command. We see that the execution of command 13 is 0. So, as soon as the android device reads the command it will execute its predefined actions. When the android phone gets command to send GPS location and send server it displays the command acquisition confirmation on screen by displaying

“GPS REQUESTED”

Then the GPSLocation.java is started and it opens the GPS hardware and sets the function sendNewLocation(location); to GPS Location manager. When the location is changed this function sends the current latitude and longitude to web server by the following URL:

[http://cuetandroid.com/index.php?option=com_cuetandroid&task=android&fnc=sendLocation&latitude="+latitude+"&longitude="+longitude](http://cuetandroid.com/index.php?option=com_cuetandroid&task=android&fnc=sendLocation&latitude=).

androidtasks.php server side script handles the request to web server made from android device. When android application sends the latitude and longitude to web server the sendLocation() function of the androidtasks.php updates the Latitude and Longitude to database. When we load the homepage of www.cuetandroid.com the web page fetch the latitude and longitude from database and create map showing the device current location using Google map [18] web service.

TABLE III
JOS_CUETANDROID COMMAND TABLE

Id	Command	Execution	Response	Value
1	1	1	null	CON_TAKE_PIC
4	13	0	22.46169205, 91.97099128	GET_LOCATION
5	21	1	null	null



Fig.12 Map showing the mobile device current location.



Fig.13 DTMF tone signal keypad on website.

We have to click on the “1” button of the DTMF command panel. We get below message as the response if the sent command is saved to database successfully.

“COMMAND SET:” TONE_DTMF_1_SET”

We get below message as the response if the sent command is not saved to database successfully.

“COMMAND DOES NOT SET:
TONE_DTMF_1_NOT_SET”

The database jos_cuetandroid is used to store, set and reset the command. We see that the execution of command 1 for command 21. So, as soon as the android device reads the command it will execute its predefined actions.

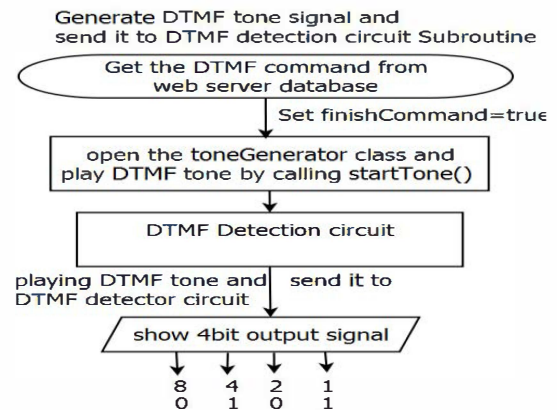


Fig. 14. Block Diagram of send DTMF signal to remote android device and DTMF detector .

When the android phone gets command to play DTMF tone and it will show the number on the phone screen and then play the DTMF tone for 1 second. This will help us generate DTMF tone[19] on Android phone by its audio hardware. We implemented 1-9 Command for simplicity purpose.

When the DTMF tone is played, the Android phone will request the server side `ajaxhelper.php` to reset all the command and the database then becomes:

TABLE IV
COMMAND TABLE

Id	Command	Execution	Response	Value
1	1	1	null	CON_TAKE_PIC
4	13	1	null	GET_LOCATION
5	21	0	null	1

We obtain digital output code 0001 in output of DTMF detection circuit when the input DTMF is 1. When the DTMF input command is 2 we get digital output 0010.

TABLE V
COMMAND TABLE

Id	Command	Execution	Response	Value
1	1	1	null	CON_TAKE_PIC
4	13	1	null	GET_LOCATION
5	21	1	null	1

V. APPLICATIONS OF THE SYSTEM

It can be used as security device by acquiring picture from its camera continuously in remote places like hilly areas where other security systems cannot be installed. As GSM network is present everywhere it can be used for monitoring purpose in any place. It can operate Motor, remote substation by using 4 bit output signal of DTMF detection circuit. This system can be used in Robotics to control the robot from remote place.

VI. SECURITY OF THE SYSTEM

Improving web application's security [20] is must because of hacking [21]. Hacking has become very severe these days. As a result, industries are paying increased attention to the security of the web applications[22] themselves in addition to the security of the underlying computer network and operating systems. The majority of web application attacks occur through cross-site scripting (XSS) [23], SQL injection [23], Cross-Site Request Forgery, Session Fixation[24]. These attacks which are typically result of flawed coding, and failure to sanitize input to and output from the web application. These are ranked in the 2009 CWE/SANS Top 25 Most Dangerous Programming Errors.

Mobile is now becoming victim of hacking. Android Security [25] is vital for our system. We must install and facilitate necessary security layers for our system. All inputs data to server must be sanitized to prevent hacking and the command in android phone will also check for wrong and malicious command.

VII. CONCLUSION

The implementation of this system will give us a flexible and easy way to monitor remote location and control electrical device using website and android phone. The more the speed and bandwidth of the GPRS/EDGE network, the system will be more reliable, as the time lag between the sending command from website and remote android mobile phone becomes small.

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