Robo-Controller Application
On
Aakash Tablet

Summer Internship 2012

Submitted in fulfillment of internship project
By

Development on Aakash Platform Team

Under the Guidance of
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DECLARATION

We Pavan Kumar Goyal, Harsharanga Patil, Nahush Gondhalekar,Shatrughn Gupta ,
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regarding the work presented in this report titled "Robo Controller " on Android
Tablet :

- This work is done wholly or mainly while in candidature for Summer
  Internship.

- Where any part of this report has previously been submitted for a degree or
  any other qualification at IIT Bombay or any other institution, this has been
  clearly stated.

- Where we have consulted the published work of others, this is always clearly
  attributed.

- Where we have quoted from the work of others, the source is always given.

- We have acknowledged all sources of help

- No part of the report is plagiarized and the report does not suffer from any
  acts of plagiarism.

Signature

Place: Date:

<u>Acknowledgement</u>

We the summer interns team of Development on Aakash Platform are over helmed in all humbleness and gratefulness to acknowledge our depth to all those who have helped us to put our ideas and assigned work, well above the level of simplicity and into something concrete.

We all thank whole heartedly **Prof. D.B. Phatak** for selecting us a part of his valuable project, constantly motivating for doing better and showing complete confidence in our work.

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Team Members

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Contents

Abstract

The application is developed to control the FIREBIRD V Robot's motion using the AAKASH tablet. The use of virtual joystick in the application makes the control smooth and efficient. An IP camera mounted on top of the FIREBIRD V Robot gives continuous video streaming and the video can be seen in the application window, also simultaneously controlling Robot's motion.

1.Introduction

1.1 Purpose

The robot's motion is controlled remotely by AAKASH TABLET through Wi-Fi simultaneously obtaining a video stream from an IP camera mounted on the top of the Robot. This principle can be used in the surveillance purpose and also can be useful in the Hostage situations E.g 26/11 Taj attack.
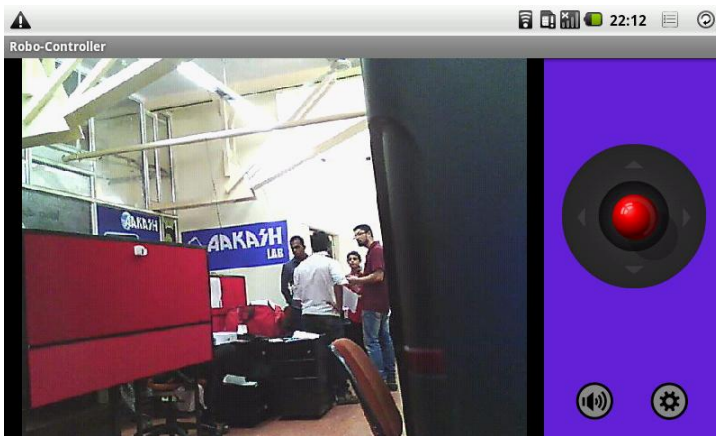
1.2 Scope

The android app code and also the embedded c code are freely available and anyone who wants to develop a similar app to control a Robot or a similar locomotion device can easily proceed with the earlier findings. Some hardware improvements and consequently some changes in the app can make this a very useful app for the surveillance purpose.

2. <u>Requirement Specification</u>

2.1 Software Requirements:

The software requirements would consist of softwares required for the following

1. <u>For Fire Bird V</u> - AVR Studio 4.17, NEX AVR STK500V2
2. <u>For WiFly Module</u> - WiFly Driver, USB to Serial COM driver, Bray Terminal
3. <u>For IP Camera</u> - Installation CD (provided with camera)

2.2 Hardware Requirements:

1. Fire Bird V (robot, programmer, charger)
2. WiFly module for Fire Bird V
3. USB to serial converter board (for configuring WiFly module)
4. IP Camera
5. Wi-Fi Router
6. Tablet
7. Windows Laptop with Wi-Fi capability

2.3 Intended Users :

Our project will target all users including:-
- Students (For learning Embedded Systems)
- Defense personnel

2.4 Operating Environment

- Android v2.2 or any greater version
- A windows PC for configurations and AVR programming
- Tools used for the android app:
  - JDK 1.6 or later
  - Eclipse IDE 3.7.2
  - Android SDK
  - ADT Plugins.

2.5 Specific Requirements

User Interfaces

User interface must be user-friendly. The user interface shall be designed using various components available in ADT plugin such as videoview for getting the video stream. A virtual joystick is used to control the Robot's motion and a settings button is provided to change the IPs of the Wi-Fi module and the IP camera.

Software Interfaces

- The Eclipse Indigo 3.7 shall be used as development environment for implementing the modules.

Communications Interfaces

- Wi-Fi connectivity will be required to control the Robot as well as to broadcast and receive the video stream.

3.Functionality

Settings: A settings button is provided in the application to change the IP of the Wi-Fi module and the IP camera if required.
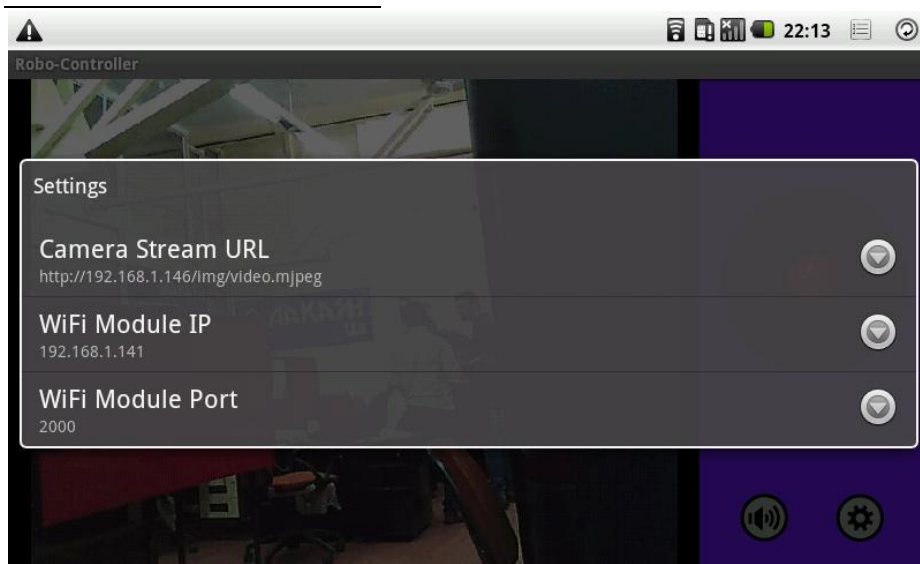
4. Configurations:

4.1 Wi-Fi Router:

1.Setup the Wi-Fi Router
 2. Power On the router
3. Connect Windows Laptop to the Router network using Wi-Fi. (e.g. For CISCO, default SSID: CiscoXXXXX)
4. Open any web browser and type the address 192.168.1.1 in the URL bar
5.Default username : admin, password: admin
 Change the SSID of the network to some convenient name

7.2 WiFi module:

1. Setup WiFly module drivers
    1.1. Put the WiFly module into the USB to Serial converter board
    1.2. Connect the USB to Serial converter board to the laptop
    1.3.Start Device Manager>Other Devices >Click on Unknown Device >Update Driver
        (If Installing for the first time)
    1.4. Install the drivers. (Path :FT232>CDM 2.08.24 WHQL Certified)
    1.5. Open Bray Terminal.
    1.6.Select COM port and connect.
    1.7.Enter command mode. (By typing $$$) and type following commands for Auto pairing type of UDP connection.

    set w a 0   //authorization: 0=open
    set w j 1   //policy for joining the network, matched stored ssid
    set w s <AAKASH>   //SSID for the access point to connect
    set wlan channel 0   // for scanning continuously
    set ip proto 1 // enable UDP as the protocol
    save
    reboot

4.3 <u>Robot:</u>

4.3.1 <u>PROGRAMMING THE ROBOT</u> :

- **Writing the Embedded C program and creation of HEX file.**
1. Creating New project in AVR Studio
2. Open a New file and add the file to the folder "Source Files" located , on the left hand side of the "Code area" window ,in the main project folder.
3. Write the required C program in code area .
4. Generating HEX file: Select "Build" menu and click on "Rebuild All". It will compile "Source_Code.c" and will generate "<Project_name>.hex" file for the Robot's microcontroller in the "default" folder in the project folder.
5. You can verify successful compilation in the bottom most "Build" Window of the AVR Studio.

- **Burning the HEX file created above on the Robot's microcontroller.**
1. Connect the programmer to the Laptop.
2. Go to Device Manager and observe that new Human Interface Device (HID) is installed.
3. Before proceeding ensure that you have AVR USB ISP STK500V2 folder which contains folder AVRDude which has files <u>avrdude.exe</u> and <u>avrdude.conf</u> .
4. Go to Start Menu- Run and type "cmd" to open command prompt.
5. In the command prompt navigate to the folder which contains <u>avrdude.exe</u> and <u>avrdude.conf</u> files.
6. On the command line type the command given below:

   <u>avrdude -c stk500v2 -p m128 -P NEX-USB-ISP -U</u>
<u>flash:w:"c:/example1.hex":i</u>

NOTE: On the command line type the command as shown in the fig. below. Here **-p m128** refers to the microcontroller part number. The last section after w: , in quotes, specifies the location of hex file. In the command line edit the part number (Here we use m2560) and hex file location as required and connect the programmer to the target board using 10 pin FRC cable provided with the programmer and turn ON the target board. (Here turn on the Robot's main board.)

7. Press Enter. You should see the programming status in the command prompt window. If there is any error, recheck ISP connection and command line parameters.
8. After successfully loading the HEX file, disconnect the programmer and power off the Robot's main board.

5. <u>Flow Diagram:</u>
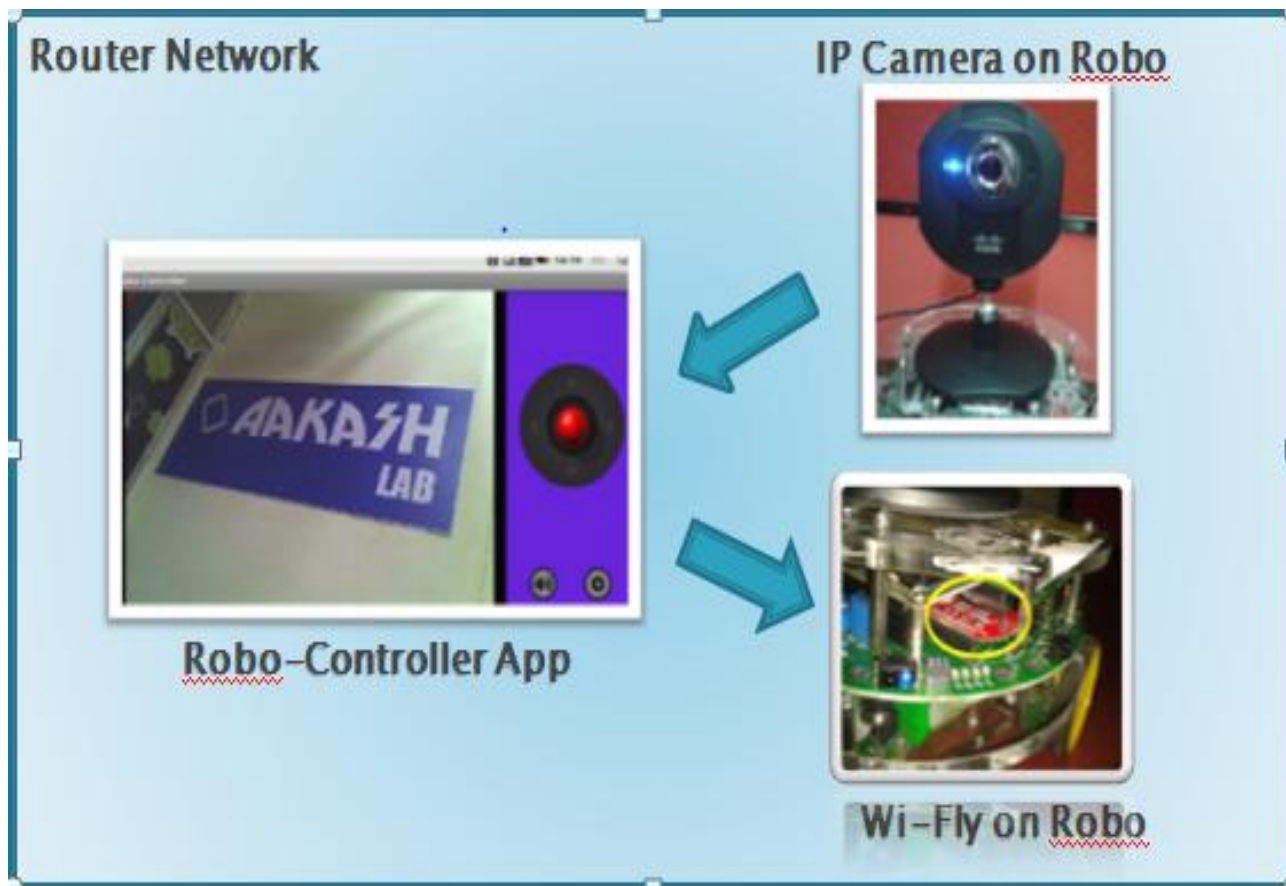
6. <u>Working:</u>

Working-Motion Control

- A virtual joystick is used in the Application to control the Robo's motion.
- 6 Different types of turns along with forward and backward motion are provided.
- Unique data is sent to the Wi-Fi

module from the application on the tablet corresponding to the area in which the joystick has moved.

- The Wi-Fi module transfers that data to the microcontroller on Robo which controls its motion accordingly.
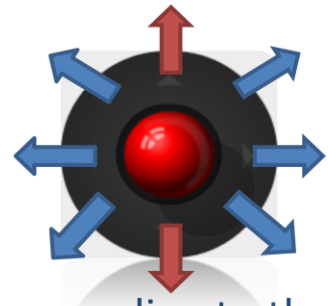
Working- IP Camera

▸ The IP camera streams its video over Wi-Fi in MJPEG format using its built-in Wi-Fi server.

▸ The application captures and decodes this stream using a predefined URL in Settings of the app.

7. <u>User Manual For Robo-Controller</u>

<u>Introduction</u>

- **Robo-Controller** is an open source software product.
- A Robot's motion Is controlled using AAKASH Tablet simultaneously receiving a video stream from an IP camera mounted on the top of Robot.

7.1 <u>Turning on the camera:</u>
   NOTE: Prior to all processes, the camera mounted on the Robot should be powered ON.
   1. Switch on the router (Robot Router): Plug in the power adapter of the router and switch ON the power supply.
   2. Connect the power cord of the battery to the camera as shown below.

NOT CONNECTED   CONNECTED

8. Switch on the power using the switch provided on the battery.

NOT SWITCHED ON   SWITCHED ON

4. LED starts blinking. Wait till it stops blinking and glows continuously.

7.2 Turning on the Robot:

1. Turn on the power of Robot by the switch as shown.
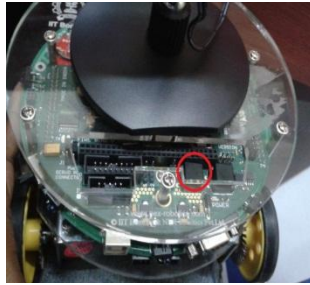
POWER OFF   POWER ON

2 . If it starts beeping, press the reset button once.

7.3 Connecting to Robot Router Network:

1. When you switch ON the tablet you will see on the screen, the display similar as shown in the figure below.

2. Make sure the Tablet is connected to the ROBO ROUTER NETWORK.

- Click on the launcher icon provided on the right hand side of the screen of the tablet as shown in the figure below.
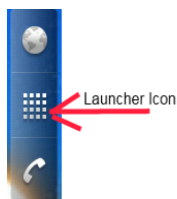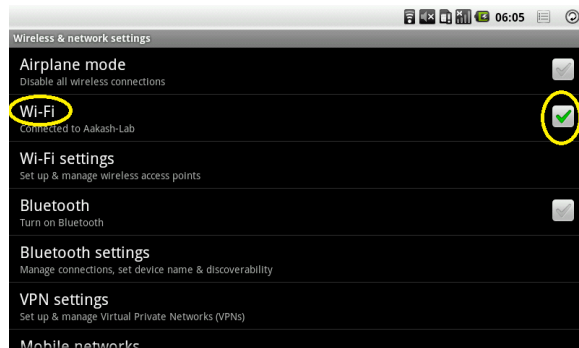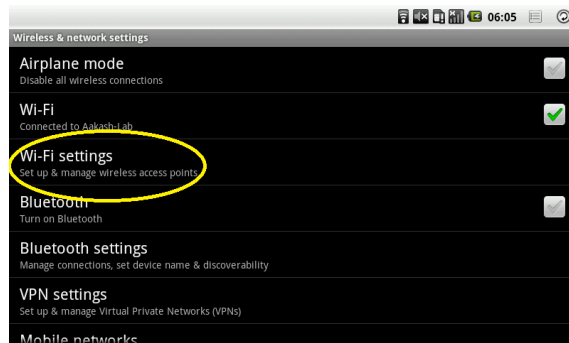

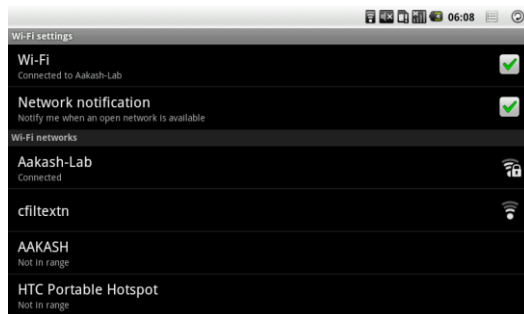- Go to SETTINGS.

- Go to Wireless and Networks
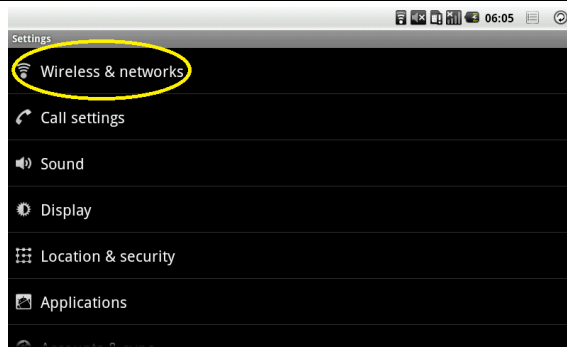
- Turn on the WI-FI

- Select WI-FI settings

- Connect to "chitti" : Password- 12345678   //Change the name and password accordingly

### 7.4 Starting the Application:

1. Click on the launcher icon provided on the right hand side of the HOME screen of the tablet as shown in the figure below.

2. Then click on the **Aakash Applications** icon present in the tablet as shown in the figure below.
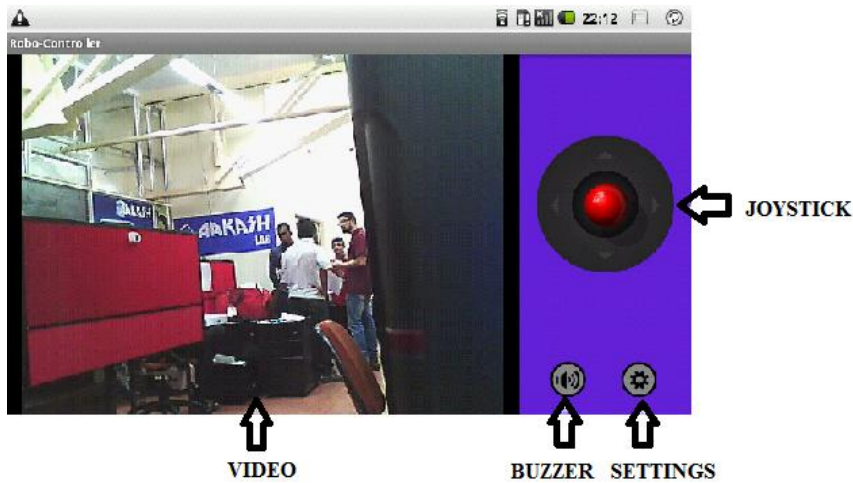

3. On click of the **Aakash Applications** icon you will see the icons of all the applications present in the **Aakash Applications** as shown in the figure below
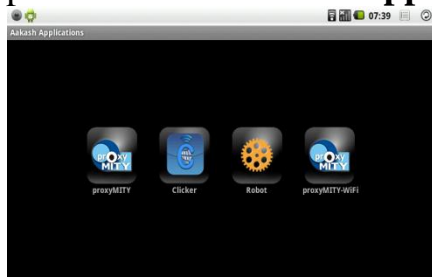

4. Go to the "Robot" application.

Robot

5. Wait till you get the continuous video streaming.
For example: As shown in the figure below

## 7.5 TO CHANGE TO ANOTHER ROBOT/CAMERA FROM THE SAME TABLET :

1. Press the settings button in the Robot Application. (Beside the BUZZER button)
   A dialog box will appears as shown below. It enables user to choose different IP
   for camera and Wi-Fi module.
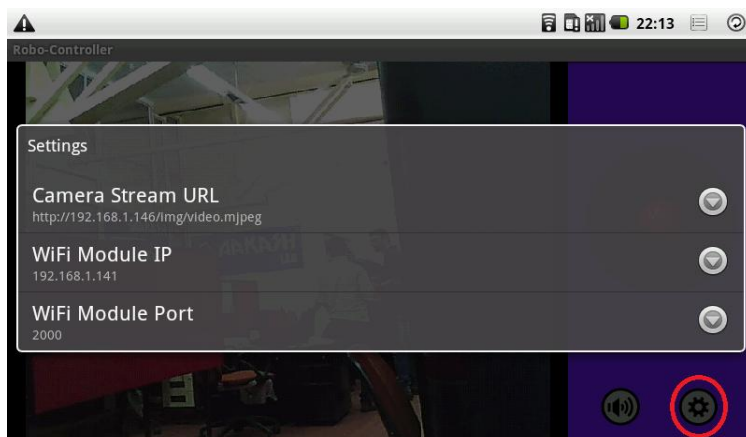
- Only change the IP addresses to switch to another Robot/Camera.

Example: Suppose the default IP addresses are: (Controls Robot 1)
For Wi-Fi module1 : 192.168.1.141
        Now if for other Wi-Fi module IP is – 192.168.1.142
Then select "WiFi Module IP" from the list and enter the required IP.
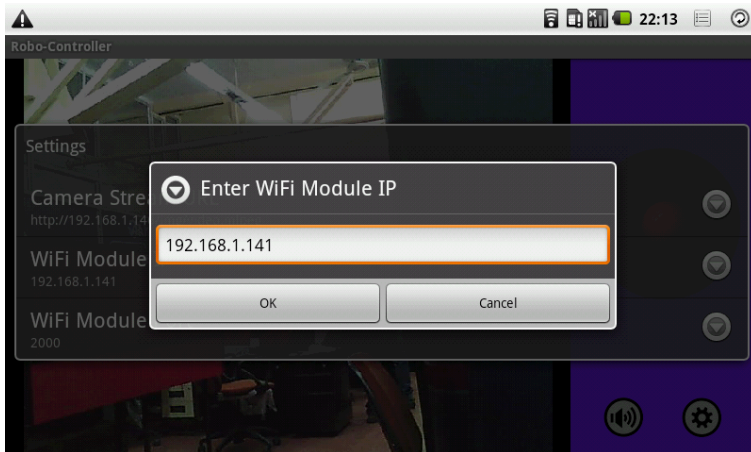
- Default URL for Camera1 – http://192.168.1.146/img/video.mjpeg
  Now if for other Camera URL is– http://192.168.1.152/img/video.mjpeg
Then select "Camera Stream URL" from the list and enter the required URL.
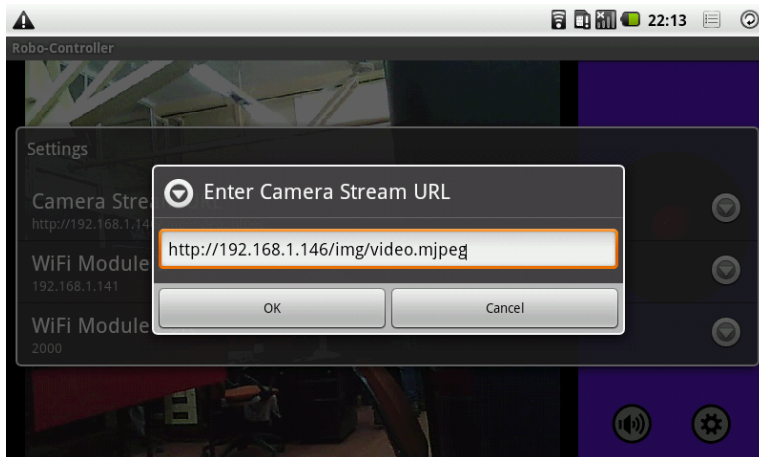
(Corresponding IPs of the Camera and WiFi module for every robot are pasted as labels on them)

NOTE: KEEP THE PORT NUMBER SAME FOR ALL. (2000)
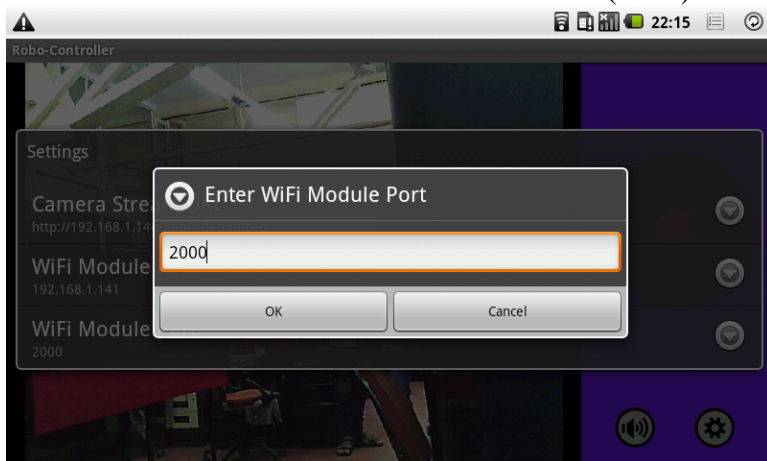
7.6 Charging the Robot:

1. Turn off the Robot using the switch.
2. Make sure the FRC cable is connected to the power board.

3. Connect the power cord to the power board

   POWER CORD-

   NOT CONNECTED   CONNECTED

4. Turn on the power supply and you will see a RED LED glowing on the board.
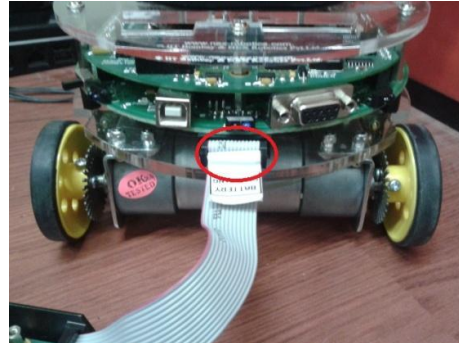

5. Connect the other end of the FRC connector to the Robot.

FRC-CABLE NOT CONNECTED   CONNECTED

6. Press the button on the power board and charging will start. It is indicated by a constant glowing GREEN LED. If LED does not glow press the button again.

7. Alternate blinking of RED and GREEN LEDs shows that the battery is fully charged. Turn off the supply and unplug the power cord.

7.7   CHARGING THE BATTERY OF CAMERA-

1. Connect the battery to the charger as shown below.

Not Connected   Connected

2. Turn on the switch.

Switched OFF   Switched ON

3. Battery starts charging and is indicated by two RED LEDs glowing. Battery charge completed in indicated by both LEDs showing GREEN light.

CHARGING   FULLY CHARGED

4. Remove the wire and unplug the charger.

8. <u>Summary and Conclusion</u>

8.1 Summary

This app is used to control a Robot remotely using AAKASH Tablet through Wi-Fi. An IP camera is mounted on the Top of the Robot which streams its video over Wi-Fi in MJPEG format using its built-in Wi-Fi server.

8.2 Further Enhancements

Adding extra hardware for making the Robot climb the steps and camera rotate functionality would be very effective in the purpose of survellience.

9. <u>References</u>

9.1 Web References

[1] Android Developer Website, http://developer.android.com

[4] Android Tutorial Website,

http://www.mkyong.com/tutorials/androidtutorial/

10. Appendix

Acronym or Abbreviation	Description
ADT	Android Development Tools
API	Application Programming Interface
APK file	Android Application Package file
GUI	Graphical user Interface
IDE	Integrated Development Environment
SDD	Software Design Document
SDK	Software Development Kit