



# How to: Programming for FTC (MIT App Inventor)

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# Programming Helpful Links – Link to App Inventor Training Manuals & Installation Guide

<https://frc-events.firstinspires.org/FTCImages/2016>

<http://www.firstinspires.org/resource-library/ftc/technology-information-and-resources>



# What is App Inventor?

- ◇ A program where you use op-modes to control the robot using a drag-and-drop feature
- ◇ You will create your own Robot Controller app



# What is VirtualBox?

- ◇ It's almost like the cloud we have for our school.
- ◇ It is a whole separate desktop within your own.
- ◇ It allows you to run virtual computers/servers on your personal computer.
- ◇ Once properly installed you will be able to run App Inventor with the FTC palettes that you need for programming.



# To Install Virtual Box

- ◇ First make sure Google Chrome is downloaded.
- ◇ Then begin downloading VirtualBox (make sure it's for Windows hosts if you are using a Windows computer).

<https://www.virtualbox.org/wiki/Downloads>

- ◇ Install the program (when opening you may have to right click and run as administrator).
- ◇ Go to the VirtualBox Appliance Files and download the appropriate file (found at the link below).

<https://frc-events.firstinspires.org/ftcimages/2016>

# Installing Virtualbox

- ◇ After downloading the file (it may take a while), in Virtualbox go to file -> Import Appliance.
- ◇ When the "Appliance to Import" window appears choose the file you have just downloaded and select the .ova file.
- ◇ Click Import when Appliance Settings pops up.
- ◇ When the Appliance has imported, click on LocalApplInventor and click the start button under VirtualBox Manager.
- ◇ Make sure you give it time to load when it starts up.
- ◇ If the screen ever locks the user shows up as ftc and prompts for a password **the password is ftc**





The virtual server's desktop displays three important pieces of information, the App Inventor server IP address, the App Inventor server status, and the build server status. You will need to know the App Inventor server's IP address in order to be able to run the application.



# Running Virtualbox

- Under your actual desktop (not Virtual Box) enter this address



<http://192.168.56.35:8888>

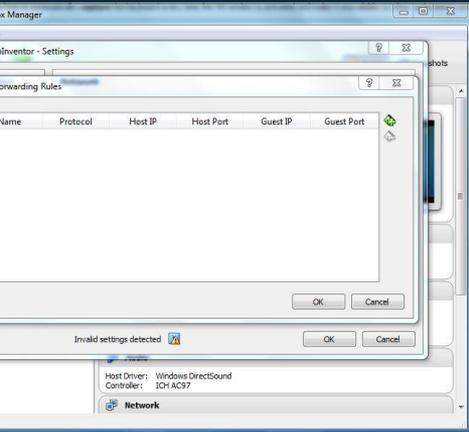
- When you first connect to the app inventor server, it will prompt you to login. You can accept the default e-mail (“test@example.com”) and click on Log In to launch the App Inventor.
- Note that your user profile and list of projects will be associated with whatever e-mail address you use to log in and what computer you are using. You could also use [somersetberkleyrobotics@gmail.com](mailto:somersetberkleyrobotics@gmail.com)

# Running Virtualbox

• Sometimes when App Inventor is not working under the Chrome tab when entering the IP address

○ Try this:

- Go to Settings Oracle VM VirtualBox Manager
- Under the Network tab in Adapter 1 click on the Advanced arrow
- Click Port Forwarding
- Click the green plus sign that Adds new port forwarding rule
- Under Host Port enter 8888
- Also, under Guest port enter 8888
- Then when loading the Chrome page enter [localhost:8888](http://localhost:8888) instead of the IP address



# Creating an op-mode

- ◇ Make sure you're in virtualbox and App Inventor and Build servos read "ok"
- ◇ Online in another tab, open <http://192.168.56.35:8888/>
- ◇ Click start new project
- ◇ Click on "FIRST Tech Challenge" to expand the palette
- ◇ Add the FtcRobotController Design component to the empty viewer plane & specify the name
- ◇ Go to properties & locate the configuration & name it to match a configuration file on the phones
- ◇ Go back to the palette drag on an FtcOpMode & rename it
- ◇ Switch to blocks mode





# What each block means

Init: what happens when the driver initializes the opmode

- ◇ Start: what happens when the start button is pressed
  - ◇ Loop: this event repeats continuously
  - ◇ Stop: what happens when the opmode is stopped
  - ◇ GetRunTime: “This is a “getter” method that returns the current runtime (in seconds) that this op mode has been running.”
  - ◇ TelemetryAddNumericData: add specific numbers that you want sent to the driver station
  - ◇ TelemetryAddTextData: send a text string from robot controller to driver station
- 

# Starting a sample op-mode

- ◇ Notice on the right hand side there are different Palettes available.  
We are using just the FIRST Tech Challenge palette.
- ◇ First drag over the FtcRobotController to the Viewer.
- ◇ Then drag over an Op mode to the Viewer.
- ◇ Drag the desired amount of FtcDcMotor(s)/FtcServo(s) and respective FtcDcMotor Controllers/FtcServoControllers to the Viewer under the Designer palette
- ◇ **Make sure you rename each motor/servo in order to match a configuration you create on the phones**
- ◇ Rename to the desired name under the Components tab AND the Properties tab



# Starting a sample op-mode (ctd)

- ◇ This is very important that all the names match within the program and configuration on the phones or else the program will not work and you will get an error message on the phones.
- ◇ Drag an FtcGamepad to the Viewer and then drag another since you can use two gamepads
- ◇ Make sure that one of the driving motors has the power set to negative with a neg block from the math Built-in Blocks tab because one motor rotates the opposite way naturally.

# How to program: blocks mode

- ◇ Now switch the the Blocks mode located on the top right corner of the screen next to the Viewer mode.
- ◇ \*Notice on the right hand side of the screen there are also different blocks: Built-in and Screen 1 (all of the blocks you have added to the Viewer)
- ◇ Click on **Variables** then drag it over to the blank Viewer add initialize global name to (enter in [GlobalStartTime])
- ◇ Then click on **Math** then drag the 0 block over to fit in the puzzle piece
- ◇ Click on the **OpMode you have named** then drag the When .Init do yellow block to the screen. This is basically what happens when the driver initializes the opmode.

\*The text that is highlighted like **this** means that it is under the left panel of Blocks



# How to program: blocks mode

- ◇ Now click on the **FtcRobotController1** then scroll down and add the block that says TelemetryAddTextData key and text
- ◇ Click on the pink **Text** block and drag two empty text boxes to key and text
- ◇ In the key text block type Mode
- ◇ In the text block type Init
- ◇ Now click on the **OpMode** again and drag over when \_\_\_\_ .Start do
- ◇ Again, click on the **FtcRobotController1** then scroll down and add the block that says TelemetryAddTextData key and text
- ◇ Click on the pink **Text** block and drag two empty text boxes to key and text
- ◇ In the key text block type Mode
- ◇ In the text block type in Start





# How to program: blocks mode

- ◇ Under the Start blocks we just worked on:

Click on **Variables** and drag set \_\_\_\_ to underneath the call Ftc

TelemetryAddTextData

- ◇ Click on the blank drop down arrow and select global GlobalStartTime
- ◇ Click on the **Op Mode** then drag over the call \_\_\_\_ GetRuntime
- ◇ Click on the **Op Mode** again and drag over when \_\_\_\_ .Loop
- ◇ Now click on the **FtcRobotController1** then scroll down and add the block that says TelemetryAddTextData key and text
- ◇ Drag over two blank **Text** boxes again
- ◇ In the key text block type Mode
- ◇ In the text block type Init



# How to program: blocks mode

- ◇ Now click on **left motor** set left\_motor Direction to
- ◇ Click on **Math** then drag over neg block
- ◇ Click on **Variables** drag over initialize local (name) to
- ◇ Enter in [leftpower]
- ◇ Then click on **FtcGamepad1** drag over FtcGamepad1 LeftStick Y this allows you to move the joystick forward and move the left motor forward
- ◇ Now click on **left motor** and drag over set leftmotor Power to
- ◇ Then click on **Variables** and drag over the get block then click on the arrow to select get leftpower



# How to program: blocks mode

- ◇ Click on **Variables** drag over initialize local (name) to
- ◇ Enter in [rightpower]
- ◇ Then click on **FtcGamepad1** drag over FtcGamepad1 RightStick Y this allows you to move the joystick forward and move the right motor forward
- ◇ Now click on **right motor** and drag over set rightmotor Power to
- ◇ Then click on **Variables** and drag over the get block then click on the arrow to select get rightpower



MyRobotController2 Screen1 Designer Blocks

- Palette**
- FIRST® Tech Challenge
- FtcRobotController
  - FtcOpMode
  - FtcLinearOpMode
  - FtcGamepad
  - FtcDcMotor
  - FtcDcMotorController
  - FtcCRServo
  - FtcServo
  - FtcServoController
  - FtcAccelerationSensor
  - FtcBNO055IMU
  - FtcColorSensor
  - FtcCompassSensor
  - FtcGyroSensor
  - FtcIrSeekerSensor
  - FtcLED
  - FtcLightSensor

**Viewer**

Display hidden components in Viewer  
 Check to see Preview on Tablet size.

Screen1

<Device>

**Active Configuration File:**  
 Wifi Direct - enabled

Robot Status:  
 -

Op Mode:  
 -

Gamepad 1  
 -

Gamepad 2  
 -

- Components**
- Screen1
    - FtcRobotController1
    - Autonomous
    - TeleOp
    - right\_motor
    - FtcGamepad1
    - FtcGamepad2
    - left\_motor
    - spinner
    - FtcDcMotorController1
    - FtcDcMotorController2
- Rename Delete

**Properties**

Screen1

AboutScreen

AlignHorizontal  
 Left ▾

AlignVertical  
 Top ▾

AppName

BackgroundColor  
 White

Backgroundimage

CloseScreenAnimation  
 Default ▾

Icon

OpenScreenAnimation  
 Default ▾

ScreenOrientation

**Blocks**

- Built-in
  - Control
  - Logic
  - Math
  - Text
  - Lists
  - Colors
  - Variables
  - Procedures
- Screen1
  - FtcRobotController1
  - Autonomous
  - TeleOp
    - right\_motor
    - FtcGamepad1
    - FtcGamepad2
    - left\_motor
    - spinner

Rename Delete

**Viewer**

```

when TeleOp .Init
do call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Init
  initialize global GlobalStartTime to 0

when TeleOp .Start
do call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Start
set global GlobalStartTime to call TeleOp .GetRuntime

when TeleOp .Loop
do call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Init
set left_motor .Direction to neg
initialize local leftpower to FtcGamepad1 .LeftStickY
in set left_motor .Power to get leftpower
initialize local rightpower to FtcGamepad1 .RightStickY
in set right_motor .Power to get rightpower
initialize local spinner to FtcGamepad2 .LeftTrigger
in set spinner .Power to get spinner

when Autonomous .Init
do call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Init

when Autonomous .Start
do call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Start
set global GlobalStartTime to call TeleOp .GetRuntime

when Autonomous .Loop
do 0 if call TeleOp .GetRuntime - get global GlobalStartTime <= 1
then call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Straight
set right_motor .Power to -1
set left_motor .Power to 1
else if call TeleOp .GetRuntime - get global GlobalStartTime <= 10
then call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Spin Clockwise
set right_motor .Power to -1
set left_motor .Power to -1
else if call TeleOp .GetRuntime - get global GlobalStartTime <= 22
  then
  call FtcRobotController1 .TelemetryAddNumericData
  key Mode
  number Straight
  set right_motor .Power to -1
  set left_motor .Power to 1
  
```

Note: this program also includes a spinner motor

As well as an Autonomous mode that goes straight and spins

# Building & Installing the App onto the Phone

- ◇ Select Build-->App (save .apk to my computer) and download it
- ◇ Use USB to transfer file to the phone using the File Manager
- ◇ App on the phone should be called MyRobotController

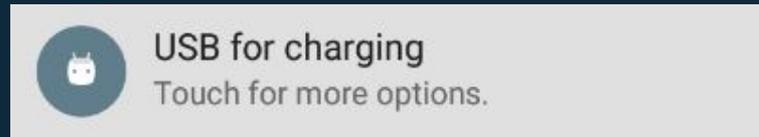
# Phone Settings

Make sure when you connect the phones with a USB to the computer they are set as a Media Device (MTP)

- ◇ Enable Developer Options by going to settings-> about phone and click on Build Number 7 times
- ◇ For configuring the phone to the robot, plug the robot controller phone into the robot (the core power distribution module), press the three dots in the corner->configure robot, create a new configuration, then scan to make sure all devices are visible.
- ◇ You may need to scan multiple times
- ◇ Once all the devices are found, under each Motor Controller/Servo Controller, add the devices plugged into each port and name them (make sure they match the program)
- ◇ When in doubt factory reset the phones and start over

# Installing the Robot Controller App

- ◇ Make sure you are using the phone labeled ROBOT CONTROLLER to install the app
- ◇ The other phone should have the FTC Driver Station App downloaded from the GooglePlay store
- ◇ The Driver Station phone connects to the GAMEPADS and the Robot Controller phone connects to the ROBOT
- ◇ Connect the phones to the computer using a USB cable
- ◇ When you slide down from the top of the screen on the phone, A banner USB for charging should appear



- ◇ Click on this banner and set the phones to Transfer files (MTP)

# Installing the Robot Controller App (continued)

- ◇ Once the phone is set for file transfer, locate the apk file you created on the host system.
- ◇ When the phone has successfully connected with the computer, this screen should pop up (See Figure 1) not go under the start menus and computer and the phone should be located as a device on the left side panel.
- ◇ Open the device to view files go to the Internal Storage folder -> Downloads folder
- ◇ Drag the apk file (probably located in downloads under the computer) into the downloads folder

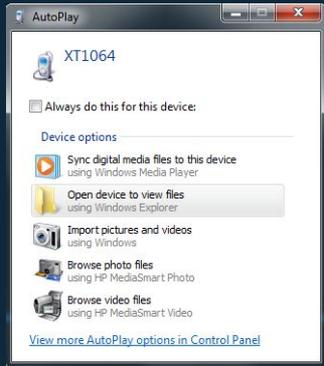


Figure 1



# Launching FTC Driver Station

- ◇ Make sure to secure the phone on the robot & plug it into the robot
- ◇ Go to the upper righthand corner and touch the three white dots to expand the settings
- ◇ Make sure to not have “Log Network Traffic” on during a match
- ◇ If needed, can restart the robot under the settings
- ◇ Make sure the controllers are connected under wifi, go to advanced, and then wifi direct





# Launching the App & Creating the Configuration File

- ◇ You'll get a notification reading "mybot.xml"
- ◇ Go back to the program to create this configuration file
- ◇ Touch the three dots in the upper righthand corner to open up the settings & open up "configure robot"
- ◇ Make a new file & rename, then save configuration
- ◇ File must match exactly how it is in the program
- ◇ Should get a "saved" popup on bottom of screen if done correctly
- ◇ Press back arrow until you're back to robot controller screen





# Pairing Robot Controller & Driver Station

- ◇ Connect the phones through WiFi direct
- ◇ Robot controller phone is the group owner under WiFi direct
- ◇ Open up settings on the FTC Driver Station App
- ◇ Click on “Pair robot controllers”
- ◇ Once you’re connected you should get a message indicating driver station is connected to a robot controller





# Selecting & Running Op-Modes

- ◇ Click on “Select Op Mode”
- ◇ Select the Op mode you want to use in order to run the program
- ◇ On the gamepad controls click Start and A at the same time for Driver 1 or click Start B for Driver 2
- ◇ Press Init
- ◇ Press start to run the op mode
- ◇ To stop, press the stop button





If you ever need  
help feel free to  
contact us.

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Flying into  
App Inventor  
like...



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