Tutorial 2

Disclaimer: In your life as a software engineer, it will be important to know how to use third party software platforms and their materials. As such, **many of the materials we recommend for this course will be third party.** This will differ from some of your other programming courses, where you will need to write most of the software yourself. It is important to develop both sets of skills, that is, using third party materials as well as knowing how to write your own programs.

Now that you're becoming more familiar with MIT app inventor, it's a good idea to spend some time learning some of the different android features you can use with this tool. In this tutorial sheet, you will find some notes and quick-links to assist with learning different features.

During the next two weeks, we'll take a look at the android phone sensors and some other miscellaneous features which can be used with MIT app inventor. These features should help you with your project later down the track.

Sensors

This week, well provide you with some information on all of the sensors. Feel free to work on these over the next two weeks. The sensors that MIT app inventor support are:

- accelerometer
- barcode scanner
- clock
- gyroscope sensor
- location sensor
- near field communication
- orientation sensor
- pedometer
- proximity sensor

For each sensor, we will include links to existing tutorials. We will also provide a small request for you to complete yourself. This might be a simple app or changes to an existing app from a tutorial. Sample solutions for these requests will be available in the coming weeks, and it will be good to view your solution in comparison to the sample.

Note that some sections in this tutorial are presented in grey. While you are free to learn as much as you like about these features (if they are of interest to you), they have been marked in grey because we feel they may not be the most important features to learn in the context of this course.

Third Party Documentation

Before we begin on the sensors, it's a good idea to have a look at the third party documentation. In software engineering, when you are using a platform developed by another entity, the software will most likely be supported by documentation with details about the functionality available for the platform. The documentation for the MIT app inventor sensors can be found **here**.

When reading the documentation on this site, you should pay attention to:

Properties:

These are the member variables of the class (or sensor) you are working with. They are basically bits of information available with the sensor, which you can use to determine, or set the state of the sensor. For example, the xAccel, yAccel and zAccel are all properties of the accelerometer. You can use these properties to determine the acceleration the phone is detecting in the x, y and z axis at any time.

Methods:

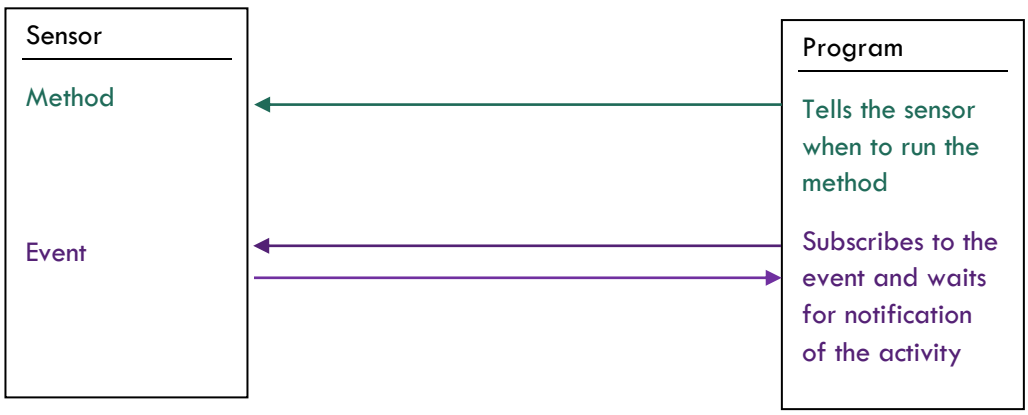
Methods allow you to give an instruction to the sensor to complete some task. For example, the click of a button might force a call to a method, such as DoScan for the QR scanner.

Events:

Events are activities or actions which the sensor can detect. You can add code blocks to an event, so that when an event occurs, you can force something to happen. For example, the accelerometer has an event which can detect if the phone is being shaken. You can make use of this event, the instruct the application what to do when it notices this event occurring.

Methods vs Events

In the most basic terms, a **method** is used to perform an action, such as updating some data, or requesting a specific activity. As a programmer, you will have the ability to decide when you wish to call a method. An **event** runs in response to an activity or set of conditions. As a programmer, you have the ability to instruct the program which events you are interested in. When that event occurs, your program is notified.



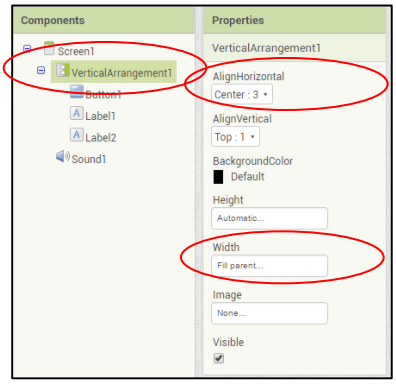
Accelerometer

The accelerometer is one of the most important features of the smartphone. It provides information about the movement of the phone, letting us know the speed and direction of travel in 3 dimensions (x, y, z). The measurements for x, y are on a scale of [-10, 10]. While the z axis gives a measurement of how gravity is affecting it. When stable, the z axis should give a reading of around ~9.8. Measurements higher than this would suggest your phone is falling toward the ground, while measurements lower would suggest your phone is being raised/lifted away from the ground.

Rapid changes in the accelerometer values are used to detect shaking and phone movement. An MIT Tutorial using this accelerometer shaking component can be found **here**. Note that this is an excellent beginner's tutorial for the platform. **It is recommended that you complete this tutorial.**

Once you have completed this tutorial, we suggest you make the layout on the screen a bit better.

In the designer page, change the **VerticalArrangement1** component settings:
Set AlignHorizontal to: Center : 3
Set the width to: Fill parent



Have a go yourself!

1. Make a soundFile you wish to play if the phone is dropped or falling, and will play if the measurement on the z axis is greater than 9.8

   Make another soundFile you wish to play if the phone is lifted or raising, and will play if the measurement on the z axis is lower than 9.8

Note that sample solutions will be provided in next week's tutorial.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

Barcode Scanner

The barcode scanner can be used for scanning both regular barcodes or QR codes. Bar codes are typically found on consumer product packaging while QR codes can be used to embed any string of text.

Note that at this time, there is no MIT tutorial on this feature. However, another detailed tutorial for this feature can be found **here.** This is an excellent tutorial, that will scan either a barcode or QR code. It will then define what has been scanned, and in the case of a barcode, it will take you to information about the product. In the case of the QR code containing a web address, it will take you directly to the page. **It is recommended that you complete this tutorial.**

When working with the Barcode Scanner, there are a couple of things you should also be aware of:

Generating a QR code

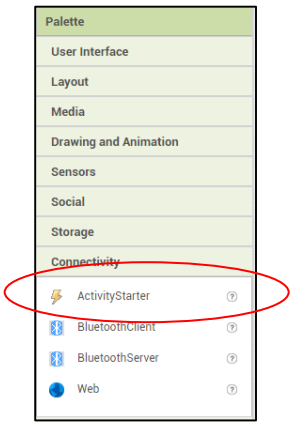
You can generate QR codes from **this** site.

1. Select Plain Text
2. Type in the text you wish to embed into the QR code
3. Select the colour
4. Download your QR code and save the file for scanning

Dependencies:

1. When using this feature with a device, you will need to ensure that the activity starter is included. The activity starter is a component which will let you fire up another application from within the application you are building. So by including the activity starter, you will be able to open up a barcode scanning application from within your application.

   The activity starter can be found on the designer page, under Connectivity (in the Palette)



   To add this to your app, simply drag and drop it onto the screen which is using the barcode scanner.

2. Your device will also require a barcode scanner application from the PlayStore. We can recommend **this** application.

   Note that when using this feature, a common Error is: "Error 1501 - your device does not have a

scanning application installed". If you receive this error, please ensure you have installed a barcode scanning application.

Limitations

The barcode scanner will only work with images viewed by the camera. It cannot scan the code of an image file which is stored on your device.

Have a go yourself!

Want to test some more with the barcode Scanner?

Create a QR code image, and keep a record of the text which is embedded.

Set this text as a global variable in your App.

Use the barcode scanner to scan the image and check if the QR code text you are expecting match

If so, display a message informing the user of the successful identification.

If not, display a message informing the user of the unsuccessful identification.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

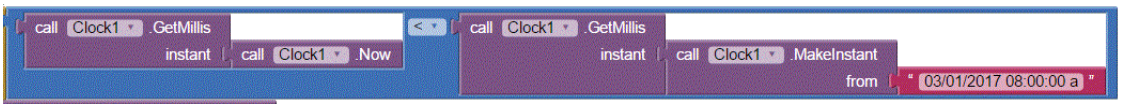
Clock

All android phones come with an internal clock. The clock library offered by MIT app inventor allows you to get and set instances in time or make use of its timer component.

MIT Tutorials using the timer or instance in time component can be found **here**: For experience with the clock timer, we recommend the MoleMash tutorial. In this tutorial, a picture of a mole will randomly jump around the screen. The player needs to tap the mole, to score points.

For experience with logging time instances, you can view the Pizza Party Tutorial. We do not recommend this tutorial, due to its limited use of clock features.

Note: The MIT tutorials do not cover an example of comparing an instance of time instance against another. Students may wish to note that the following sample of code allows you to make this comparison.



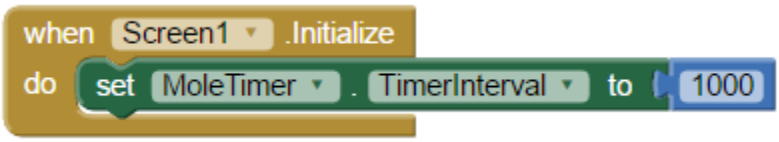
How does this work? All clocks in UNIX systems are set from the initial UTC time of 00:00:00 - 01/01/1970. The MIT app inventor allows you to convert any instance in time to the number of milliseconds which have passed since this initial time. The number of seconds which have passed will be represented as an integer. From here, you can run an integer comparison (using the math library comparison function) to find the relation between any two instances in time.

Have a go yourself!

Update the MoleMash Tutorial

Next to the reset button, include 2 new buttons for "faster" and "slower"
Hint: You may want to use a horizontal alignment for these.

When Screen1 is initialized, set the timerInterval to 1 second (or 1000 milli-seconds)
Hint: The initialize method is an event in Screen 1, and the timerInterval is a variable in the moleTimer. You will need to use an integer from the Math library to set the value of the variable.



When the button faster is pushed, make the mole move twice as fast.
Hint: set the value of the timerInterval to its current value / 2

When the button slower is pushed, make the mole move twice as slow.

Make sure you update the reset button, so that the time is re-set to its initial value when this button is clicked.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

Gyroscope Sensor

The gyroscope sensor can measure angular velocity in three dimensions in units of degrees per second. The Gyroscope detects rotation and can measure angular velocity in three dimensions in units of degrees per seconds. It is considered more sensitive, precise and faster than the accelerometer, and while all android phones will likely have an accelerometer, only the better ones will have a gyroscope.

Note that at this time, there is no MIT tutorial on this feature. There is also little supporting material which we are able to find on this sensor.

Have a go yourself!

Create an app that displays the XAngularVelocity , YAngularVelocity and ZAngularVelocity at any point in time.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection, provided the phone has this sensor included.

Location Sensor

Android phones come with a location sensor. Using this sensor, it is possible to find the longitude and latitude of a devices current location. This information can then be used in applications such as google maps.

MIT tutorials using the location sensor can be found **here**: **It is recommended that you complete both the "Android, where's my car?" and the "Map It: Displaying Locations on a Google Map".**

Note that the above tutorials are advanced. While it is recommended that you complete these, you should allow a couple of hours for their completion.

Have a go yourself!

The provided tutorials showcase this sensor well. There is no need to complete another tutorial about this sensor.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

Near Field Communications Sensor

Near Field Communication (NFC) is a wireless radio communications standard (a little like wi-fi or Bluetooth) which is only applicable for short range communication. It enables two electronic devices, to establish communication by bringing them within 4cm of each other. The NFC readers are not particularly specialized, so NFC chips are incorporated into many smartphones.

An NFC chip in your phone works in conjunction with an NFC tag. The NFC tags are small, and don't have any power source. Instead, they literally draw power from the device that reads them, thanks to magnetic induction. When a reader (such as the chip in your device) gets close enough to a tag, it energizes it and transfers data from that tag.

It is an emerging technology, with increasing significance. It is embedded NFC tags incorporated into credit cards which provide the backbone for the development of tap and go payment systems, and is the driver behind mobile payment systems and mobile wallet solutions.

An MIT tutorial about this sensor can be found **here. There is no need to complete this tutorial, unless you wish to get very accustomed to NFC. This is an advanced tutorial, and requires purchased NFC tags to work. Instead, we recommend you complete the following tutorials.**

Have a go yourself!

~~Did you know your student card has an NFC tag? Create an App which reads and displays the information stored on your student card. Note that a sample solution will be provided in the coming weeks.~~

//TODO: NFC tag in student card is not compatible with NFC library. Need to purchase compatible tags (topaz, 512, r/w) and come up with a tutorial/exercise.

IMPORTANT: Applications built with the NFC component will not respond to tags while in live development mode. **To test your application, you must build your app and download the APK to your phone**.

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

Orientation Sensor

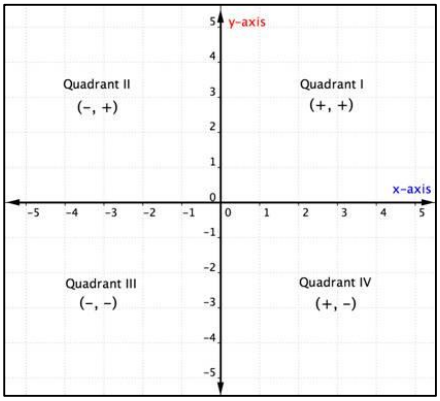
The orientation sensor is another component which can determine a phone's spatial orientation. That is, it will measure the phones tilted angle in space. If you think this sounds similar to the accelerometer, then you are correct. In fact, it is now recommended by google to use the accelerometer as the orientation sensor is its predecessor. **BUT IT IS STILL AN EXCELLENT SENSOR TO LEARN AND PLAY WITH**!

At this time, MIT tutorials for the use of this sensor do not exist.

Because it can measure the degree of the angle, it is excellent for controlling the movement of an object on the screen. Sample tutorials for controlling the movement of an object can be found **here** and **here**. **It is recommended that you complete one of these tutorials.**

Want to test some more with the Orientation Sensor?

1. Using the orientation sensor, roll a ball around the screen and then display which Cartesian quadrant (using the x and y values) the ball is currently in.



For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection.

Pedometer

pedometer activities can be tracked using an android device. The pedometer senses motion via the accelerometer and attempts to determine if a step has been taken. Using a configurable stride length, it can also estimate the distance travelled.

Note that at this time, there is no MIT tutorial on this feature. However, another detailed tutorial for this feature can be found **here**

Want to do some more

Add some conditional statements to the pedometer from the tutorial.

If the txtStringLength text field has no value, display the message "Please enter a stride length"

If the txtStringLength text field has a negative value, display the message "Stride length cannot be negative"

Create a global flag that lets you know if the pedometer is running
Hint: set a global variable to true of false to indicate the pedometers state.

If the pedometer is running and the user clicks on the btnStartMeasuring, display the message "Pedometer is already running".

If the pedometer is not running and the user clicks on the btnStopMeasuring, display the message "Pedometer has not yet started."

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection, though you may wish to take care when using the USB connection.

Proximity Sensor

This sensor defines the proximity of an object relative to the device screen. Most proximity sensors are simply light sensors that will detect "proximity" when they are covered.

Note that this feature is not available on all android devices.

There is no MIT tutorial on this feature, however, a simple youTube tutorial can be found **here**

For students using the emulator

Note that this feature is not available for students using the emulator. This sensor will work for students using a phone via a wifi connection or USB connection