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DATA MATCH



technology (App Inventor; dweet.io; freeboard.io; programming, big data)

Information and Communications Technology

This project is recommended for students older than 15 years.

1 | SUMMARY

Since 2015, FIFA has authorised the use of tracking systems for official matches i.e. data-collection trackers for all players on the pitch. Off the pitch this data can be then examined and analysed to inform managers, trainers and players regarding players' performance.

These systems are also used during training sessions and for testing physical performance, providing data in real time. These wearable devices (for example watches or chips embedded in the player's clothes) collect significantly large amounts of data, such that these data sets, when collected, can be designated as Big Data.

This unit helps students to send big data in real time via mobile devices.

2 | CONCEPTUAL INTRODUCTION

The collection of real-time GPS data on the football pitch using memory technology is becoming increasingly important in the development of player performance, in the planning of training, in the prevention of injuries and in the development of tactics boards.

In any single football game approximately 1.5 million player positions can be captured by cameras and sensors. This GPS data can be used to measure and calculate a player's speed (pace),

acceleration and changes of direction.

Analysis of this data can also tell coaches when a player can return to the field after injury or when a player has a high risk of injury. Other examples of the type of data that can be gathered instantaneously using sensors in the players' shirts include body temperature (development of heat maps on the pitch), heart rate, percentage of oxygen, and the lactic acid concentration of blood.

Different software applications are needed to store, process, analyse and visualise such large amounts of data in a convenient and effective way.

3 | WHAT THE STUDENTS DO

This unit will enable students to send big data in real time using their smartphones. Students will become app developers, designing and making their own applications using the App Inventor^[1] program. The real-time data will be collected via this app and then sent to an online data-sharing website (dweet.io) which is linked to a screen-mapping website (freeboard.io). All aforementioned programs are free and can be used remotely in the cloud. Students will learn how to publish data they have collected and share it in the cloud.

3 | 1 App Inventor

MIT App Inventor is an innovative, easy-to-use program for app creation and development. It is highly suitable for first-time programmers and very student-friendly. Note: you have to create an account before using App Inventor.

Here is a step-by-step guide how to develop a football app to gather real-time GPS data from your students while on the football pitch (FIG. 1).

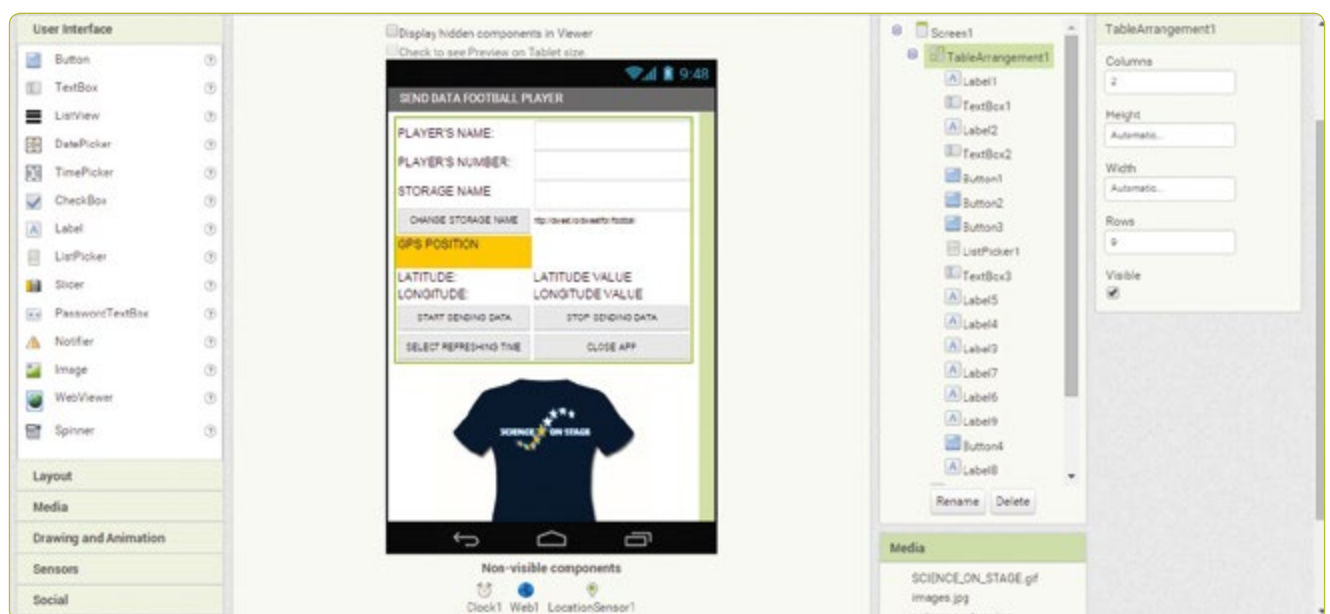


FIG. 1 Screenshot of App Inventor

3 | 1 | 1 App Inventor screen design

Open App Inventor, click *new project* and enter a name for your new project, e.g. *Send Data Player*. You will then be automatically directed to the designer section.

On the right-hand side of the screen you will find a list of screen properties you can choose in order to design screen content.

FIG. 1 was designed using the following steps:

- **Screen1.** AlignHorizontal: CENTER; AppName: SEND DATA PLAYER; Icon: SCIENCE_ON_STAGE.GIF; Title: SEND DATA FOOTBALL PLAYER
- **TableArrangement1.** Columns: 2; Rows: 9
- **Label1.**Text. PLAYER'S NAME:
- **Label2.**Text. PLAYER'S NUMBER:
- **TextBox1.** Hint: Introduce your name
- **TextBox2.** Hint: Introduce your number; NumbersOnly
- **TextBox3.** Hint: Introduce your storage name
- **Label3.**BackgroundColor: Orange; Text: GPS POSITION (see FIG. 2)
- **Label4.**Text. LATITUDE:
- **Label5.**Text. LONGITUDE:
- **Label6.**Text. LATITUDE VALUE:
- **Label7.**Text. LONGITUDE VALUE:
- **Label8.** FontSize:9; Text:http://dweet.io/dweet/for/football
- **Button1.** FontSize:11; Text: START SENDING DATA
- **Button2.** FontSize:11; Text: STOP SENDING DATA
- **Button3.** FontSize:11; Text: CLOSE APP
- **Button4.** FontSize:11; Text: STORAGE NAME
- **Label9.**Text. STORAGE NAME:

- **ListPicker1.** FontSize:11; Text: SELECT REFRESHING TIME (SECONDS)
- **Image1.** Picture: SCIENCE_ON_STAGE.GIF
- **Clock1.**TimerEnabled: NO; Timer Interval: 5000 (every 5 seconds)
- **Web1.** Url: http://dweet.io/dweet/for/thing (e.g. http://dweet.io/dweet/for/football; the "thing" is, in this case, "football", but you can choose any name your class would like)
- **LocationSensor1.** Time Interval: 1,000 (every 1 second)

3 | 1 | 2 App Inventor blocks programming

Click on the *Blocks* tab on the menu bar (FIG. 1).

Click *Button1* to activate the data-transmission clock and disable changes to the player's name and number.

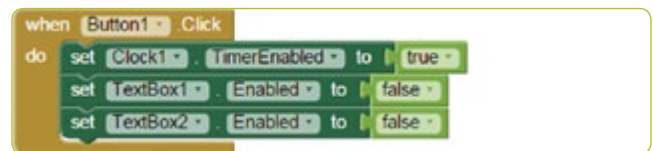


FIG. 3

Click *Button2* to disable the data-transmission clock and enable changes to the player's name and number.

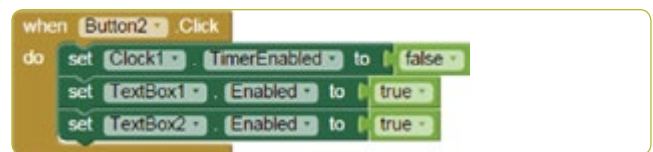


FIG. 4



FIG. 2 Components of TableArrangement1

Click *Button3* to close the application.

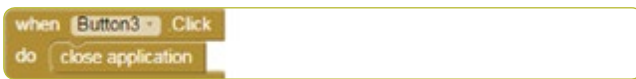


FIG. 5

Click *Button4* to change the URL of the file where you want to publish data at dweet.io.



FIG. 6

When the GPS sensor detects a change in latitude or longitude, this data is recorded in *Labels 6 and 7*.

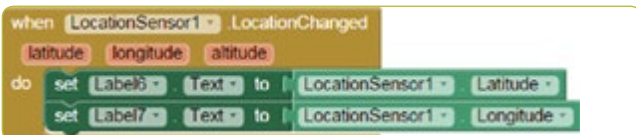


FIG. 7

The recorded data, along with the player's name and number, as well as the latitude and longitude of his or her position, are sent at regular intervals and every five seconds by default (FIG. 8).

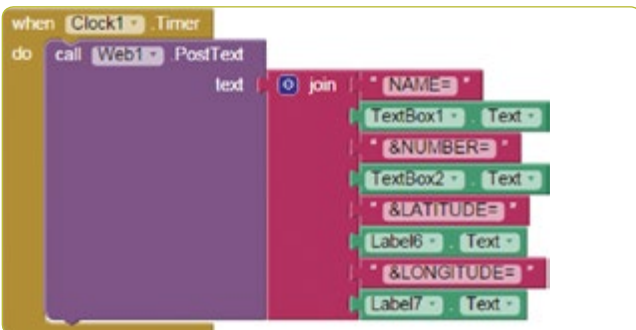


FIG. 8

The *ListPicker1* tab allows you to refresh time information in seconds; from 1 to 20 seconds (FIG. 9).

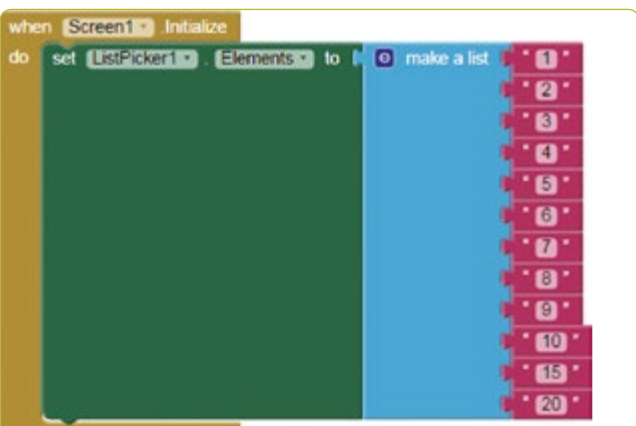


FIG. 9

The *Timer Interval* field is defined in milliseconds. (FIG. 10)

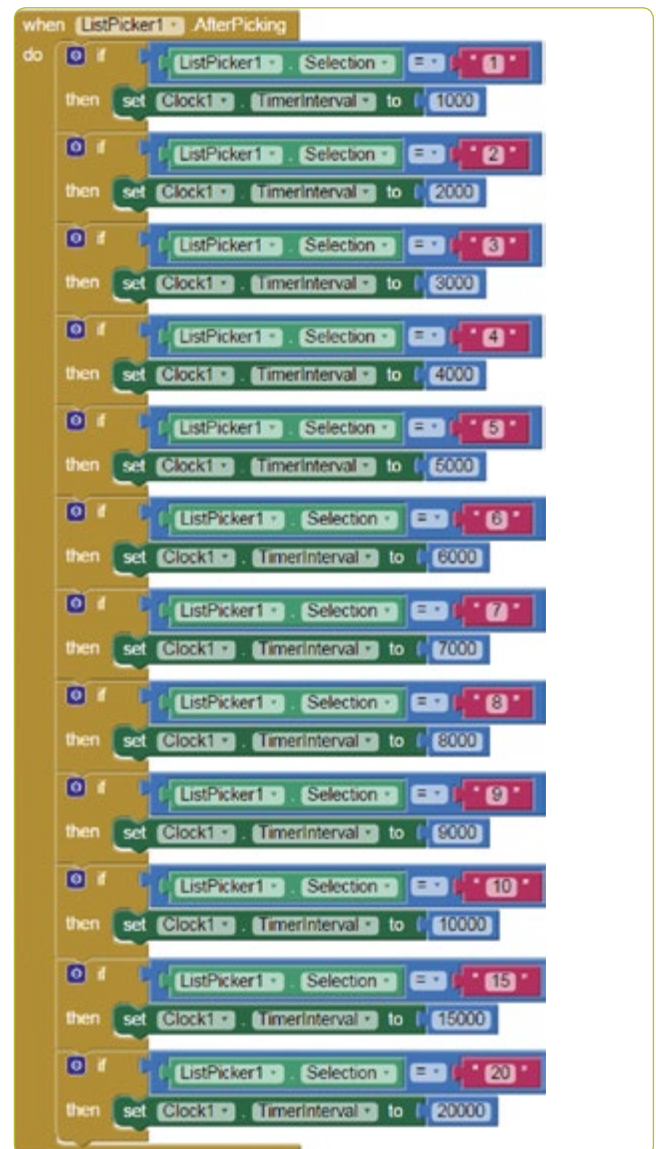


FIG. 10

3 | 2 Data storage on dweet.io

dweet.io is designed to publish data from sensors (FIGS. 11 and 12). This is more popularly known as the Internet of Things (IoT). dweet.io assigns a unique URL for every *thing*.

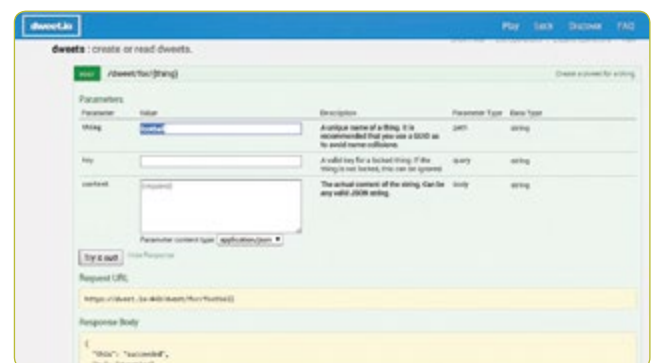


FIG. 11

- Select *PLAY*
- Click the *POST* tab.
- Write the storage name you want in the *thing* field. The storage name in the app has been set as *football* in the example shown in this resource. Therefore it must also be called *football* here in *dweet*.
- Click *Try it out!*

Using the *GET* tab.

To view the data stored, go to: `get/tweets/for/{thing}`, enter the *STORAGE NAME* chosen for you (by default *football*) and click *Try it out*.

3 | 3 Visualisation of data on freeboard.io

Freeboard is an open-source, real-time dashboard builder for the Internet of Things.

- Click on *Start Now*
- Enter a name and click *Create New*
- Click *Add Datasources* tab
- Click *Select a Type* and choose *Dweet.io*
- Enter a *Name: football*
- Enter *Thing Name: football*
- Press *Save*
- Click on *Add Pane* tab
- Click + symbol
- Click on *Select Type* and choose *Text*
- Title: *Player*
- Click on *+Datasource: Football and Name*
- Click *Save*
- Click on *Add Pane* tab and choose *Pointer*

- Click on *+Datasource: Football and Number*
- Click *Save*
- Click on *Add Pane* tab
- Click + symbol
- Click *Select Google Map*
- Click on *+Datasource: Football and Latitude*
- Click *Save*
- Click on *Add Pane* tab
- Click + symbol
- Click *Select Google Map*
- Click on *+Datasource: Football and Longitude*
- Click *Save* (FIG. 13)

4 | CONCLUSION

This teaching unit encourages students to develop their own application for sending data in real time. It provides an opportunity to gather “real data” on the pitch via smartphone—a tool that most students have in their pocket.

Students see that a smartphone is all that is needed to collect the data required and to increase the number of parameters to be studied at same time.

There are many options for data analysis. For example, students can plot and analyse the positions of the players of a complete team on a pitch by means of the following tools:

- Create an Excel file containing the latitude and longitude of all the players.
- Go to www.earthpoint.us and select *Excel to Google Earth*, select your Excel file, and click on *View on Google Earth*.

The screenshot shows the dweet.io interface. At the top, there are navigation links: Play, Lock, Discover, and FAQ. Below that, there are utility links: Show/Hide, List Operations, Expand Operations, and Raw. The main content area is titled "dweets : create or read dweets." and contains three API endpoints:

- POST** /dweet/for/{thing} - Create a dweet for a thing.
- GET** /get/latest/dweet/for/{thing} - Read the latest dweet for a thing.
- GET** /get/dweets/for/{thing} - Read all of the saved dweets (up to last 500) for a thing.

Below the endpoints is a "Parameters" table:

Parameter	Value	Description	Parameter Type	Data Type
thing	football	A unique name of a thing.	path	string
key		A valid key for a locked thing. If the thing is not locked, this can be ignored.	query	string

There is a "Try it out!" button and a "Hide Response" link. Below that is the "Request URL" field containing: `https://dweet.io:443/get/dweets/for/football`. The "Response Body" field shows the following JSON response:

```
{
  "this": "succeeded",
  "by": "getting",
  "the": "dweets",
  "with": [
    {
      "thing": "football"
    }
  ]
}
```

FIG. 12

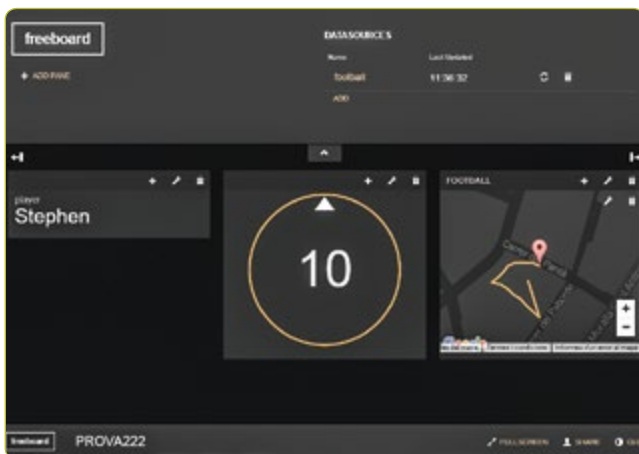


FIG. 13



FIG. 14 Student with bib to record data

- On Google Earth: check that the players' positions are being plotted on the location where they were playing football.

Further developments

- Match evolution: students can order these files chronologically, watching them like a film and analysing how the team moves and behaves during a specific period during a match.
- Area covered by a team: after producing a Google Earth view of the team's positions, students can use the *Polygon Area* utility, available from the same source. Following the easy instructions, students can calculate the area enclosed by the players' positions so as to determine whether they were playing as a scattered assembly or unified team.

5 | COOPERATION OPTIONS

Students can organise cooperative projects between different schools. For example, the students at one school might take measurements in real time, while students from another school analyse the data. This methodology can also be used to study other sports.

RESOURCES

[1] MIT App inventor <http://ai2.appinventor.mit.edu/>

- <http://usuaris.tinet.cat/pcompte/football/> BIG DATA: Sending Data in Real Time
- www.realtracksystems.com/ WIMU Real track systems
- <http://go.sap.com/solution/industry/sports-entertainment/team-management/sports-one.html> SAP Sports One



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