

# Design Applications for Girls on Raspberry Pi Platform

**Q8 Engineering team**

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## **Executive Summary**

In developing countries, they do not have access to science, technology, engineering, and math (STEM) education. In addition, women lack access to economic opportunities. Facts about education shows that girls are still being denied education. There are millions of girls out of school, leaving them behind most of developed countries. Q8 engineering team designed a tablet on raspberry pi platform to give students access to mathematics and science education and improve economic opportunity for women. The team have divided their design phase into two main sections, hardware and software design. Using Internet and raspberry pi, the students would have access to outside educators. Access to STEM will improve students' job potential and improve the overall economic opportunities for developing countries.

Hardware design consist of screen, accessories, case, and power. Q8 engineering team with the help of Engineering design students have designed a case that hold all parts of raspberry pi together and acts as a stand. Accessories, such as wireless mouse and keyboard, would help girls use the tablet at schools. Powering the raspberry pi was through renewable energy system and using a charger that stabilize the voltage and current coming from sunlight. Software phase includes, operating system, switching raspberry pi to personal hotspot, and applications. Personal hotspot on the tablet will save the amount of money consumed on internet access. Applications installed in the tablet are, python, LibreOffice, PiNet, PDF reader, Scratch, and internet browser. Python will allow kids to learn programming and create projects that will help their society. PiNet help schools and students to have a raspberry pi classroom through shared server. LibreOffice is a free document application that supports all Microsoft files, helping kids do assignments for school.

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## 1.0 Background

Millions of girls in developing countries are still being denied an education. This issue is worldwide and slow education progress for girls nowadays will have a huge impact in society over lifetime. To resolve this issue, Q8 engineering teams are concerned the girls' educational issues, using internet source for boosting STEM education, and technologies that interface with resolving girls' education.

### 1.1 Girls Education issue and facts

There are still around 58 million of girls don't have the opportunities of having education. Statistics shows that one in four children suffers from health issues, which reduce their odds of a decent education [1]. There are still 31 million girls are not attending primary schools. Of these 17 million are probably not attending schools for their whole life. Based on UNESCO, in Nigeria there is around five and half million, Pakistan over three million, Ethiopia over one million are out of school [2]. According to the 2011 Tanzania Education Sector Analysis, the 2009 Primary School Leaving Examination (PSLE) pass rate for the region of Manyara, in which Lesoit resides, is 56% vs. 70% for Dar es Salaam [3]. The PSLE scores in Table 1.1 show the pass rates for the Math and Sciences subjects for 2009 [3]. The table below shows there is huge clear gender disparity with females having lower scores than the males.

**Table 1.1 PSLE Math and Sciences Pass Rate by Gender 2009**

<b>PSLE Math and Sciences Pass Rate by Gender</b>		
Gender	Male	Female
Math	25%	17%
Sciences	60%	47%

Girls' education has a huge impact on all of societies around the world. Researchers have found that educating girls can save millions of lives, improves child health, reduce the birth rate in early ages, reduces the gap between men and women, higher chances in finding work, and much more. In Brazil, if women had secondary education that would increase the chance in getting a job by 60%.

### **1.2 Internet and Education**

The Internet is useful nowadays for society seeking for better knowledge, it has shifted the world into a new phase. A phase of communication and online entertainment, educational purposes, and much more [4]. Internet contain vital knowledge all around the world with one step to take, which is exploring. Students have extra resources and information about certain subjects which save girls from buying and holding heavy textbooks [4]. Internet can offer online classes that being taught thousands of miles away. If girls in rural area don't have access to school, she could still get access to education by having classes through internet access. Communication between the teacher and student would be easier with any condition. Improving communication between a teacher and a student would give the opportunities to advantage for teachers to help girls away from them.

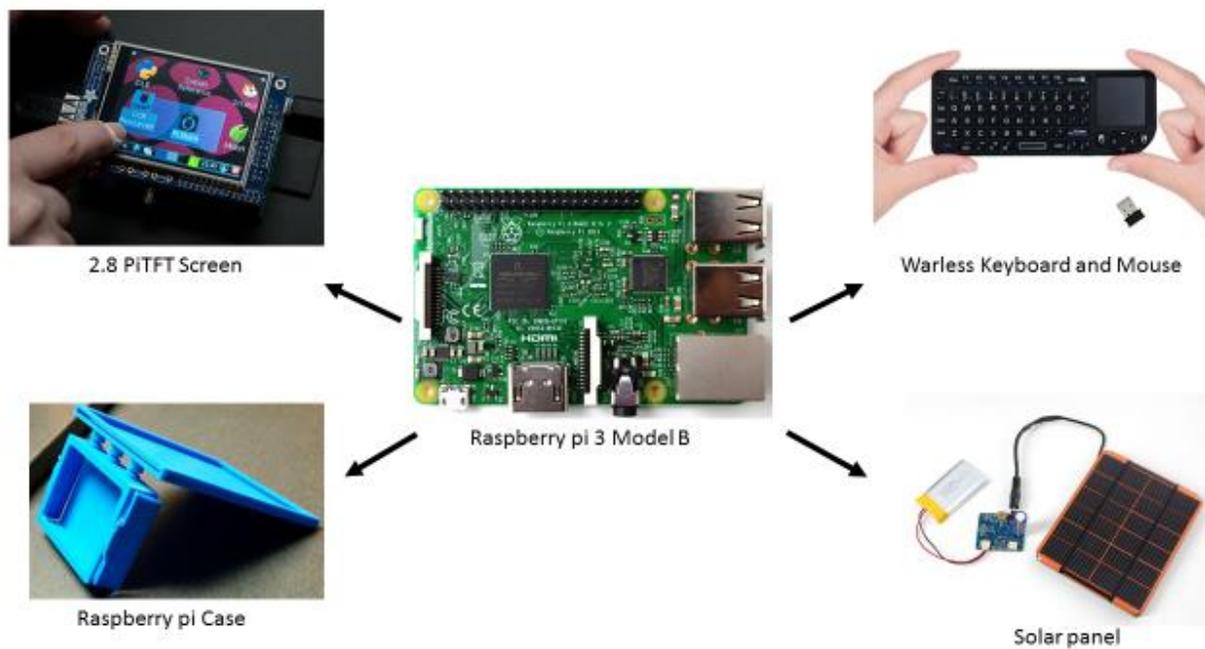
### **1.3 Technologies Interface with Education**

Wealthy regions can afford more and better teachers and have more resources like electricity, internet, and computers [5]. Without bringing new technology to developing countries, these trends will continue unaddressed. In order to use the internet, girls need to have a new educational technology. Tablet is one of the best options girls could have in increase education proficiency. A research study shows that kindergarteners students have better scores on literacy

when using tablets than those who don't tablets [6]. According to Houghton Mifflin Harcourt in California, stated that using tablets made students score 20% more in their math test [6].

## 2.0 Design Hardware Phase: Solar powered tablet using internet access

Raspberry pi micro-controller is a small credit card sized computer with various functions. Q8 engineering team designed a raspberry pi tablet powered through renewable energy source and various connectors with its design to resolve the problem addressed above. In the flow chart below, it shows the all hardware designs Q8 team considered in their tablet.



**Figure 1: Hardware Design Flowchart**

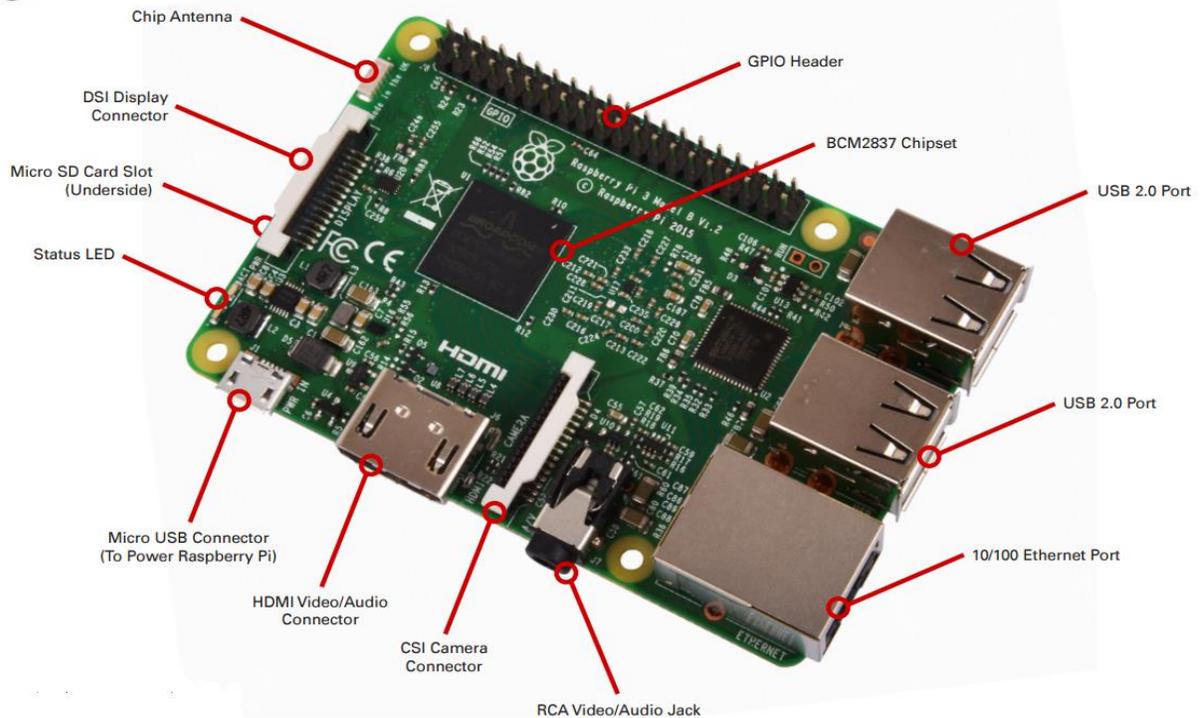
### 2.1 Raspberry Pi Components

The Raspberry Pi Micro-Controller is a small, credit card sized computer with a design based upon the BCM2835 System on an S O C [7]. It contains 1 G bytes of RAM and has sockets for boot media and persistent storage. The computer is sold as a bare, single motherboard unit

without power supply, housing, keyboard, mouse and screen [7]. Because of these factors, it is a low cost base that lends itself to be built into a number of different fully functioning devices such as tablets, GPS and GSM modules, image processors for ASV's and medical devices, and many others. Raspberry Pi has various connectors within its design such as RCA Video, Audio, Ethernet, HDMI, DSI Display and USB to connect to different devices and operate of the computer [7].



## Raspberry Pi 3 Model B



**Figure 2: Raspberry Pi 3 Design Architecture [7]**

1. Processor; Broadcom BCM2837 SoC with a 64 bit processor-1.2GHz quad-core arm cortex-A53 CPU.

2. Micro USB Connector; transports the micro USB port voltage and turns it into the 5V USB, 3.3V, 2.5V and 1.8V core voltages. These are needed for the Ethernet and processor components of the computer.
3. General-Purpose Input / Output (GPIO); a 40 generic pin on an integrated circuit. The pins are connecting the Pi to the outside world and can be programmed to interact in a number of impressive ways. Inputs do not have to be physical connections; they can also be sensor or come from another device or computer.
4. Wi-Fi; 802.11b/n Wi-Fi and Bluetooth 4.1
5. CSI Camera Port; a port to connect the Pi with a camera.
6. USB Port; 4 channels that are connection ports for peripheral devices such as mouse, keyboard etc.
7. Audio/Video; provides connection points with audio out devices such as speakers or headphones.
8. Card Socket; Micro SD socket requires a flash card to store the operating system and files.
9. Mounting Holes; 4 holes in the corners of the board, used to physically attach the Pi to something such as a touchscreen.
10. LED; Used for indicator lights.
11. HDMI; a port used to connect the Pi with compatible devices such as HD television with an HDMI cable for a clearer picture or video streaming.
12. Ethernet; a port used to connect the Pi with a wire network.
13. DSI Display Connector; a port to connect the Pi to a touchscreen.

## 2.2 Adafruit 2.8” Touch Screen

The chosen screen towards the project is the 2.8-inch touch screen. This screen will be connected to raspberry pi 3. To start off with the 2.8-inch, the touch screen’s sensitivity with 10 fingers capacitive touch. The resolution of this screen 320 x 240 pixels which is high. Visually, the 2.8-inch screen is harder to view from but it is still functional in viewing objects but not as good as the 7-inch touch screen [8]. This screen requires a minimum of 1.3 watts of electric power in order to work [8]. The 2.8” requires to be programmed in order to function with the raspberry pi. The steps below show how the screen is programmed in the raspberry pi 3 [9].



**Figure 3: 2.8” Touch Screen Display [9]**

- Run “sudo apt-get update”
- Write this command to distribute the configured files - curl -SLs  
<https://apt.adafruit.com/add-pin> | sudo bash
- [pi1]device\_tree=bcm2708-rpi-b-plus.dtb

```
[pi2]device_tree=bcm2709-rpi-2-b.dtb
```

```
[all]
```

```
dtparam=spi=on
```

```
dtparam=i2c1=on
```

```
dtparam=i2c_arm=on
```

```
dtoverlay=pitft28r,rotate=90,speed=32000000,fps=20
```

- Rotate=90 tells the users to rotate the screen in different degrees, horizontally or vertically. 0 degree is portrait view with USB jacks in the bottom and 90 degrees is landscape with headphone jack in the bottom. You can change the view by changing the variable 90 to 0 and replot the raspberry pi.
- Speed variable shows how fast the sequence of screen moves. Q8 engineering team used 32 MHZ to shows the screen clearer and faster.
- Restart by the command “sudo reboot”
- ```
sudo mv /usr/share/X11/xorg.conf.d/99-fbturbo.conf ~
export FRAMEBUFFER=/dev/fb1
startx
```
- After programming the screen, there is some calibration needed to be done for the touch function.
- Run 

```
sudo nano /etc/udev/rules.d/95-stampe.rules
```
- ```
SUBSYSTEM=="input", ATTRS{name}=="stmpe-ts", ENV{DEVNAME}=="*event*",
SYMLINK+="input/touchscreen"
```
- Remove and re-install the touch screen with 

```
sudo rmmod stmpe_ts; sudo modprobe
stmpe_ts
```

- Then, Is-I /dev/input/touchscreen and this command will show eventx, x is a number that will be changed since we have keyboards/mice/usb devices that will be connected.
- Run evtest by sudo evtest/dev/input/touchscreen then press on the touchscreen to restart.

### 2.3 Raspberry pi Case

Q8 engineering team with the help from Engineering Design I student have designed a simple case that gathered all the hardware part together. The idea behind this case is to prevent the raspberry pi from breaking down and act at the same as a stand for the kids. First step in our design was gathering the dimensions for all parts and use solid works to 3D print the case. The figures below show the dimensions of all parts and the final view.

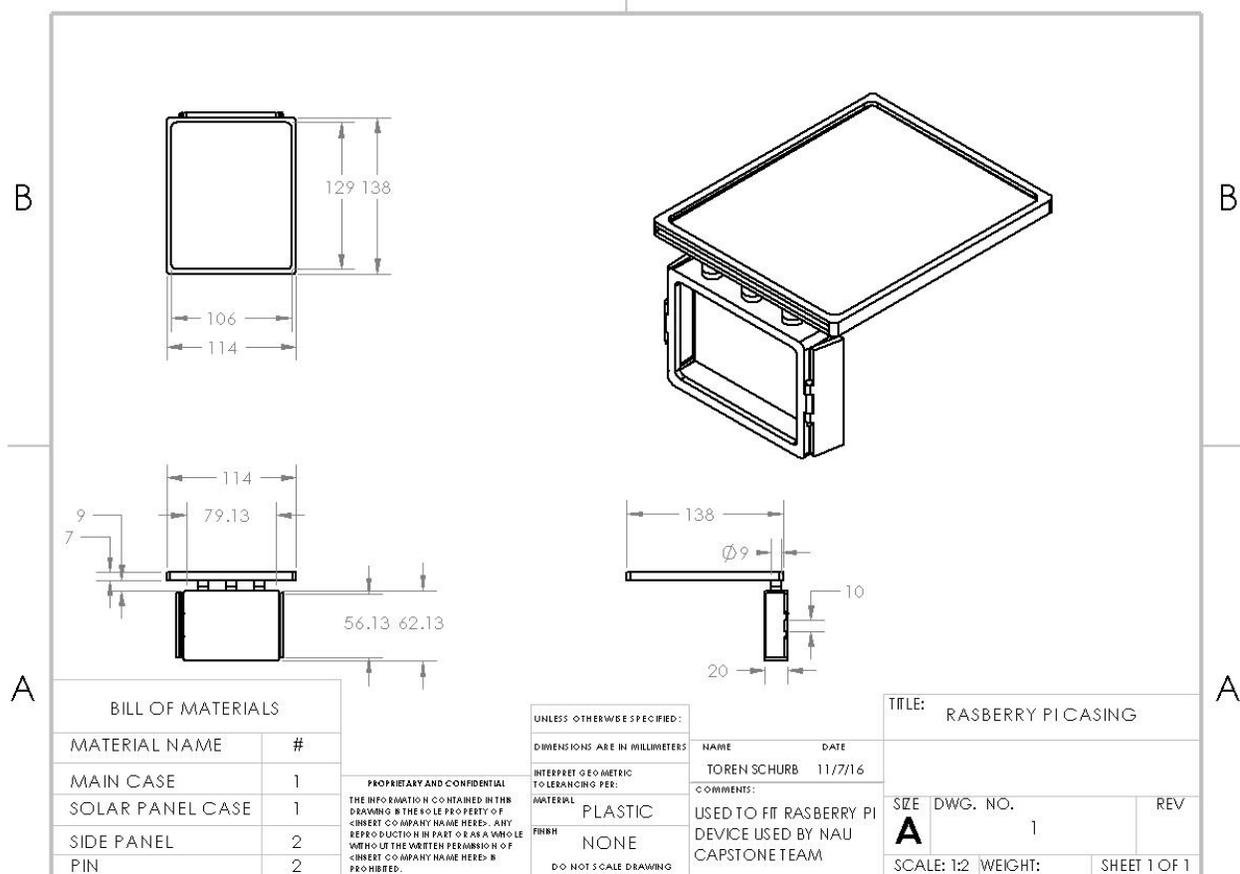
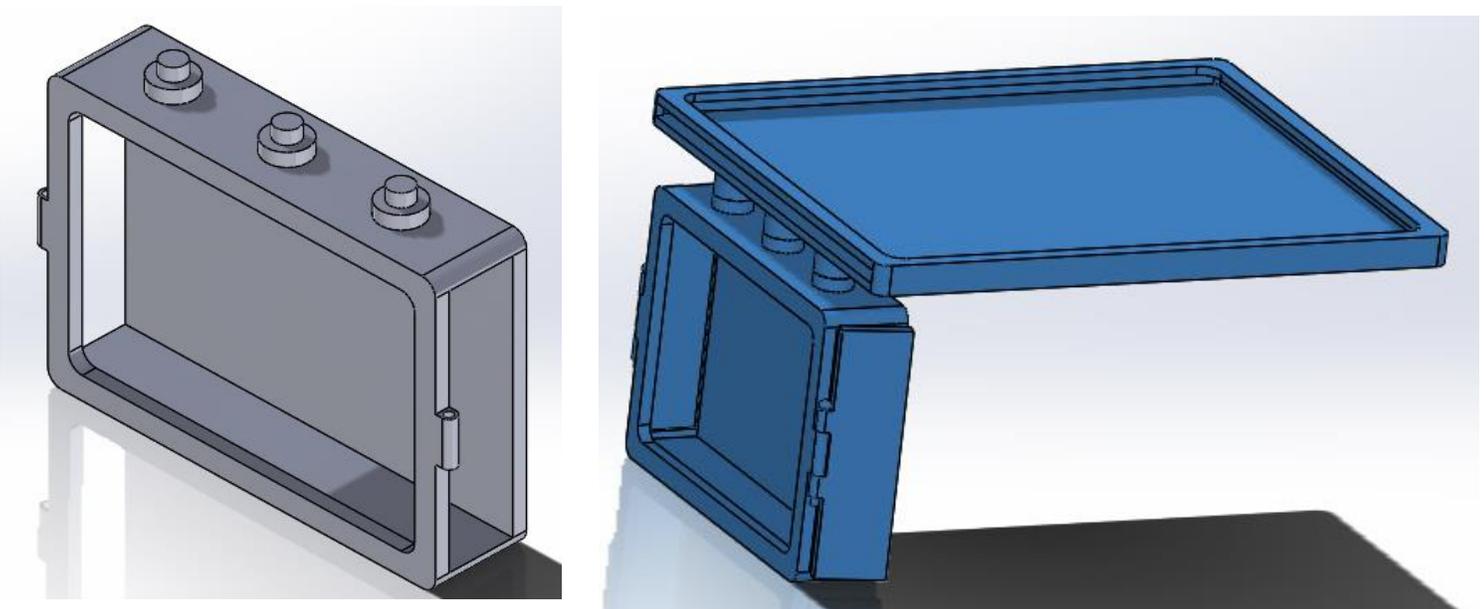


Figure 4: DAGPI Case Dimensions in Solidworks



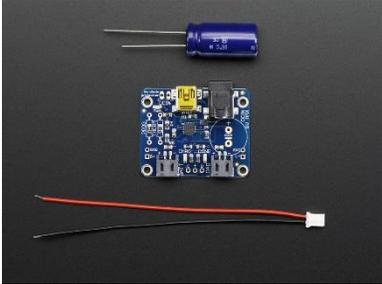
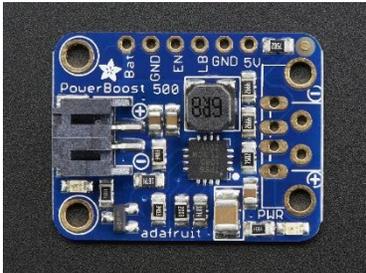
**Figure 5: Top and Side View of the Case**

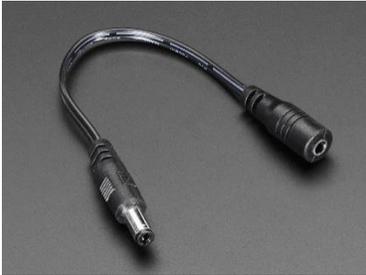
## 2.4 Solar Panel Powering

Most developing countries in world are located in Africa [10]. Many African countries are exposed to a lot of sunlight because of its location near the equator [11]. Rural areas, especially dry areas, gives solar power the potential to distribute energy through the access of sunlight [10]. Q8 engineering team have designed a connection that would power the raspberry pi through high efficiency monocrystalline cell [12]. The table below shows the material and their specifications

**Table 2.4: Solar Power Specifications**

Product		Specification
Medium 6v 2w solar panel		<p>A panel that is waterproof. They use a high efficiency monocrystalline cell. They output 6V at 330 mA via</p>

		3.5mm x 1.3mm DC jack connector
<p>USB / DC / Solar Lithium Ion/Polymer charger - v2</p>		<p>This charger is a very unique design, perfect for outdoor projects, or DIY iPod chargers. The current is going high due to sunlight visibility which requires a capacitor to stabilize the power. Also 2 pin JST cable where it connect the BATT or LOAD.</p>
<p>PowerBoost 500 Basic - 5V USB Boost @ 500mA from 1.8V+</p>		<p>Power boost has low battery detection, excellent efficiency, high frequency, DC/DC boost converter module can run from 1.8V batteries or higher, and convert that voltage to 5.2V DC for running your 5V projects</p>

<p>3.5 / 1.3mm or 3.8 / 1.1mm to 5.5 / 2.1mm DC Jack Adapter Cable</p>		<p>DC jack adapter that connect the panel into Lithium Ion Charger</p>
<p>Lithium Ion Polymer Battery - 3.7v 2500mAh</p>		<p>Lithium ion polymer batteries are thin, light and powerful. The output ranges from 4.2V when completely charged to 3.7V. This battery has a capacity of 2500mAh for a total of about 10 Wh.</p>

### 2.4.1 Power Installation

In order to power the DAGPI through solar panel there are certain steps to follow [13]:

- Install the large filtering capacitor in the polymer charger. The capacitor is necessary to stabilize the solar panel since it will charge a lot of current, the capacitor needs to be 4700 uF. The flow of charge is the electric current as exposing to sunlight, so it stores energy. A number of farads in a capacitor tells how much it can stores energy. Current is rate of flow so the equation of calculating current through capacitor is  $i = c \frac{dv}{dt}$ .
- Install the capacitor in the PCB by soldering the wires of the capacitor into the pads. The positive lead of the capacitor must be soldered with the must side of the pad.

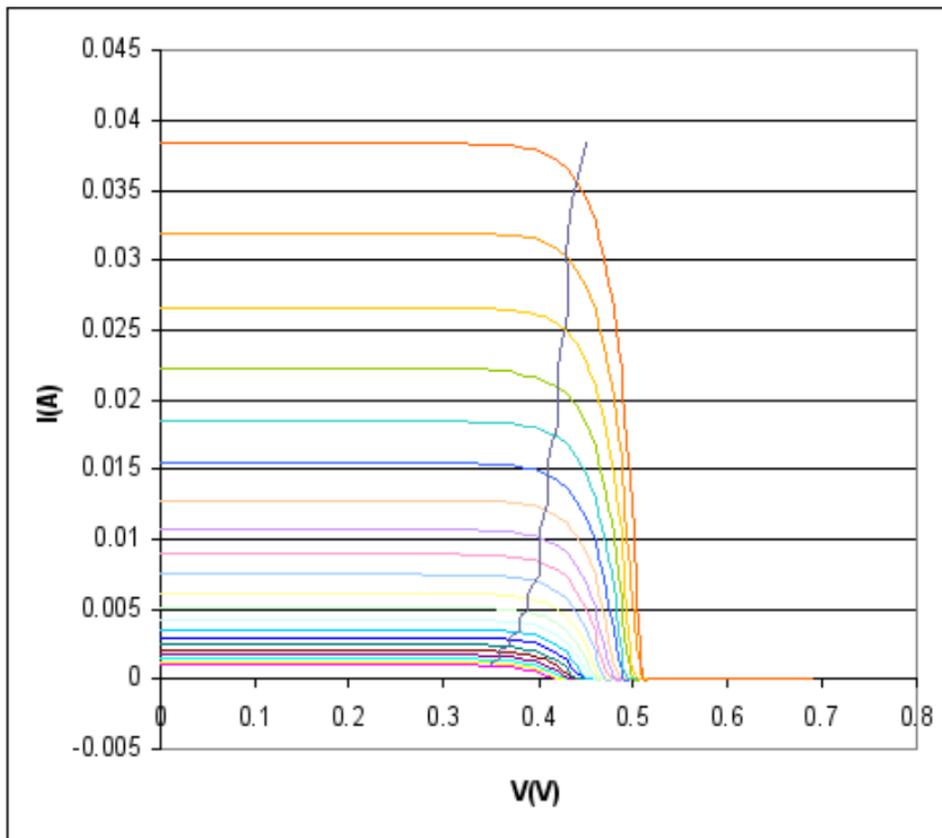
- Connect the DC Jack Adapter cable with the wire attached in the solar panel
- If there is red PWR LED it indicate that the solar panel is providing power
- Control the current by calculation, there is a port on the Polymer charger called **RPROG** **where is the resistance**. If you want to control the current, it depends on the resistance.

The current is set by  $\frac{1000}{R_{PROG}}$ , In our design we want 1A current so we would use a 1K ohm resistor.

- Connect the lithium ion polymer battery into polymer charger by soldering the JST cables
- Raspberry pi horizontally charged from USB to micro mini USB, so we choose power booster to connect the DAGPI directly through the USB port.

#### 2.4.2 Solar Optimization and Analysis

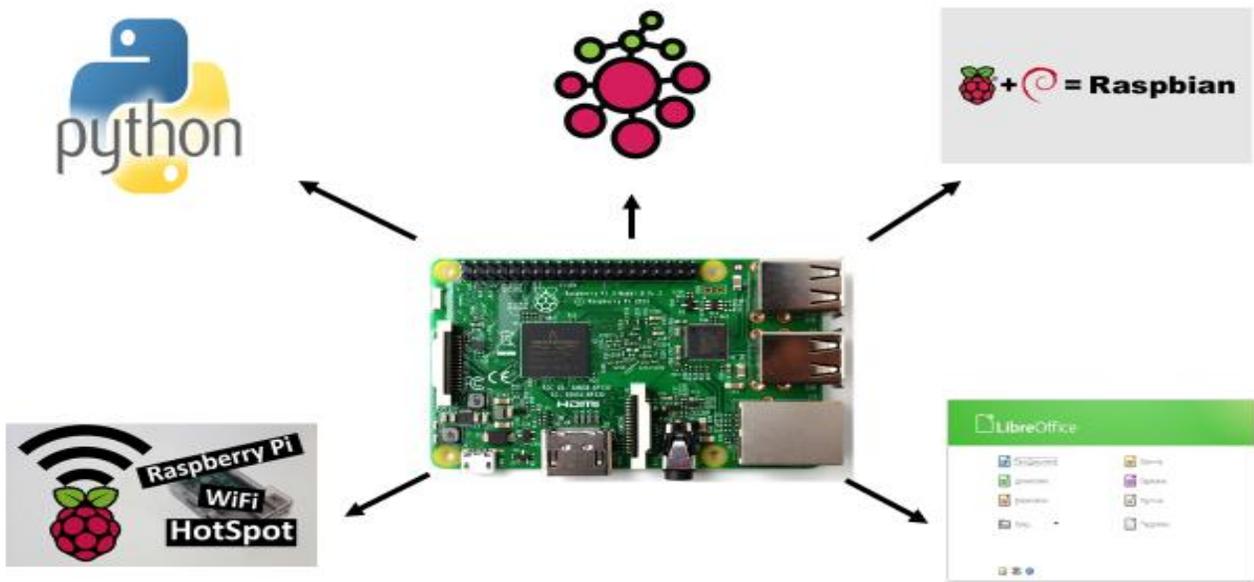
Many questions come on mind, why would we use a solar charger? Without the solar charger the battery takes forever to charge due to the efficiency. When using a wall port, the voltage doesn't change a lot even with the fact of current draw [13]. Solar panels are different since voltage and current are unstable and depends on the availability of sunlight [13]. The battery will act different, either turns on and off to draw more current or draw less current to keep voltage from falling down to zero. In the figure below, when no current the voltage is around 0.5V, as current increases the voltage starts to drop. In the polymer chip there is a chip called MCP73871 that we can set the voltage to a point that the current can random to keep the voltage maintained [13]. There is a diode charges the capacitor from the panel to prevent voltage from draining.



**Figure 6: Solar cell I-V curve in varying sunlight**

### 3.0 Design Software Phase: Software Applications

The second phase of Q8 engineering team design is software application. Software phase consist of programming the operating system, switching the raspberry pi to personal hotspot, and applications that would increase the proficiency of STEM education in girls. In the flow chart below, it shows the all software designs Q8 engineering team considered in their tablet.



**Figure 7: Software Design Phase Flowchart**

### **Raspbian Operating system**

Raspbian is a free operating system intended for raspberry pi platform [14]. The operating system is the GUI interfaces with basic applications that makes the raspberry pi runs. Raspbian is developed by some fans of raspberry pi for educational process [14]. Q8 engineer team used Raspbian among all other operating systems due to its simplicity and functions. The steps below the team took to install Raspbian on the raspberry pi [7].

### **Raspbian Installation**

In this section, it shows the steps requires to install the operation system for Raspberry pi 3[7].

- 1- Download the latest version of Raspbian from the Raspberry Pi website.
- 2- Download the "win32 disk imager" from the Raspberry Pi website.
- 3- Writing the Image; plug in the SD card into the device, then select the right image file from the downloaded file and Save to the SD card.
- 4- Setting up the Pi;
  - a- Raspberry Pi booting default username and password "use whenever needed "

Login: pi

Password: raspberry

b- Set-Up Option for the Configuration Screen;

“In case of missing the setup option screen please type “sudo rasspi-config”

- Select “ Expand File system” → Enter
- Select “ enable boot to desktop/scratch” → Enter
- Choose boot options select “desktop log in as user pi” → Enter
- The pi should reboot automatically after step 4 if not use manual reboot type
- “sudo reboot”

5- Update firmware

- When the pi reboot is done open a terminal file from desktop and type the command “sudo rpi-update”

### 3.1 Setting Raspberry pi as a Wi-Fi Access point

Internet is one the main advantages for improving education rate in developing countries. Q8 engineer team have evaluated internet options that could be implemented in developing countries. Each alternative has its own advantages and disadvantages. There are five most promising providers of internet nowadays, which are, Facebook, cellular data, cable connection, and google loon. Facebook launched a new project that provides basic internet services that is free of charge after partnership with the satellite Eutelsat. Facebook will work in partnership with satellite operator Eutelsat, where the two companies will buy full bandwidth of the satellite package Amos-6[15]. The problem facing Facebook project is it have limited access to the web; meaning you can access facebook.com but you can't access YouTube. Google loon is a research project that is developed by google to connect the people in rural areas and remote areas. The project contains materials, such as, helium balloon, solar panels, and electronics box [16]. Google loon project is a high cost project. This design needs a helium noble gas which is hard to

provide in rural areas. Cellular data is mostly common internet access around the work with more advantages than others, such as, simple implementation, high coverage, and fair price. Taking example of cellular data in Tanzania, Airtel is one of the most innovative mobile phone operator launched in October 2001. Airtel provides cellular internet access with a 40 GB allowance [17]. In order to get most of the student connected through their cellular data the team intends on turning raspberry pi into personal hotspot. Instead of having 100 raspberry pi with 100 cellular data subscribed, sharing data by switching raspberry pi into a personal hotspot. The table below shows the total saving with turning raspberry pi to personal hotspot.

**Table 3.1 Capital cost for Airtel and personal hotspot**

<b>Airtel Internet Subscription</b>	<b>Monthly Allowance (GB)</b>	<b>Number of Users</b>	<b>Unit Cost (USD dollars)</b>	<b>Total Cost 12 Month (USD)</b>
Personal Data	40	30	55	660
Personal Data with Personal Hotspot	40	15	55	330
			<b>Total saving (\$)</b>	330

According to the table above having two user share the same data source will cut the price by half. This advantage would help save money for other purposes and help students to share their data at homes.

In order to configure the DAGPI to personal hotspot there are certain steps to follow [18]:

- **Install software and checking that its connected to Ethernet Connection**
  - sudo apt-get update
  - sudo apt-get install hostapd isc-dhcp-server
- **Set up DHCP Server**
  - Edit the file that allows Wi-Fi connections to automatically gets IP addresses, DNS, etc.
  - Find the lines that say option domain-name and add pound sign in the beginning
  - Remove the pound sign in front authoritative

- Scroll down and add these commands
  - subnet 192.168.42.0 netmask 255.255.255.0 {
  - range 192.168.42.10 192.168.42.50;
  - option broadcast-address 192.168.42.255;
  - option routers 192.168.42.1;
  - default-lease-time 600;
  - max-lease-time 7200;
  - option domain-name "local";
  - option domain-name-servers 8.8.8.8, 8.8.4.4;
  - }
- Save the file by typing in Control-x then Y then return
- Run command `sudo nano /etc/default/isc-dhcp-server`
- Scroll down to `interfaces=""` and update it to whatever you want to name your wifi adapter by `Interfaces="Q8ENGINEERING"`
- Set up Q8TEAM for static IP
  - Run `sudo nano /etc/network/interfaces` to edit the file
  - Find the line `auto Q8ENGINEERING` and add a pound sign in front of the line
  - Add these lines
    - `iface wlan0 inet static`
    - `address 192.168.42.1`
    - `netmask 255.255.255.0`

- After allow-hotplug Q8ENGINEERING add # after each line as shown in the figure below

```

GNU nano 2.2.6 File: /etc/network/interfaces Modified
auto lo

iface lo inet loopback
iface eth0 inet dhcp

allow-hotplug wlan0

iface wlan0 inet static
    address 192.168.42.1
    netmask 255.255.255.0

#iface wlan0 inet manual
#wpa-roam /etc/wpa_supplicant/wpa_supplicant.conf
#iface default inet dhcp
  
```

Figure 8- Network configuration for static IP

- **Configure Access point**
  - **In the following commands it will set up a password-protected network for authorized people to connect.**
  - Create new file by running `sudo nano /etc/hostapd/hostapd.conf`
  - Write the following commands
    - `interface=Q8TEAM`
    - `driver=rtl871xdrv`
    - `ssid=Pi_AP`
    - `country_code=US`
    - `hw_mode=g`
    - `channel=6`
    - `macaddr_acl=0`
    - `auth_algs=1`
    - `ignore_broadcast_ssid=0`

- wpa=2
  - wpa\_passphrase=Raspberry
  - wpa\_key\_mgmt=WPA-PSK
  - wpa\_pairwise=CCMP
  - wpa\_group\_rekey=86400
  - ieee80211n=1
  - wme\_enabled=1
- For the DAGPI to find configuration file run `nsudo nano /etc/default/hostapd`
- Edit line `#DAEMON_CONF=""` to  
`DAEMON_CONF="/etc/hostapd/hostapd.conf`
- Edit line `DAEMON_CONF=` to `DAEMON_CONF=/etc/hostapd/hostapd.conf`
- **Configure Network Address Translation**
  - Configuring the NAT will allow more than one user to connect to the Wi-Fi
  - Run `sudo nano /etc/sysctl.conf`
  - Add `net.ipv4.ip_forward=1`
  - Run `sudo sh -c "echo 1 > /proc/sys/net/ipv4/ip_forward "`
  - `sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE`
  - `sudo iptables -A FORWARD -i eth0 -o wlan0 -m state --state RELATED,ESTABLISHED -j ACCEPT`
  - `sudo iptables -A FORWARD -i wlan0 -o eth0 -j ACCEPT`
  - `sudo iptables -t nat -S`
  - `sudo iptables -S`
  - Run the following command so that every time you reboot you don't have to write the lines all over again: `sudo sh -c "iptables-save > /etc/iptables.ipv4.nat"`

## 3.2 Raspberry pi Applications

As raspberry pi become more integrated with education access, Q8 engineering team have installed and formatted the GUI interface for students to apply them to the learning process. The main applications that was programmed and being installed are, python and scratch, PiNet, LibreOffice and pdf reader.

### 3.2.1 Python Programming Application

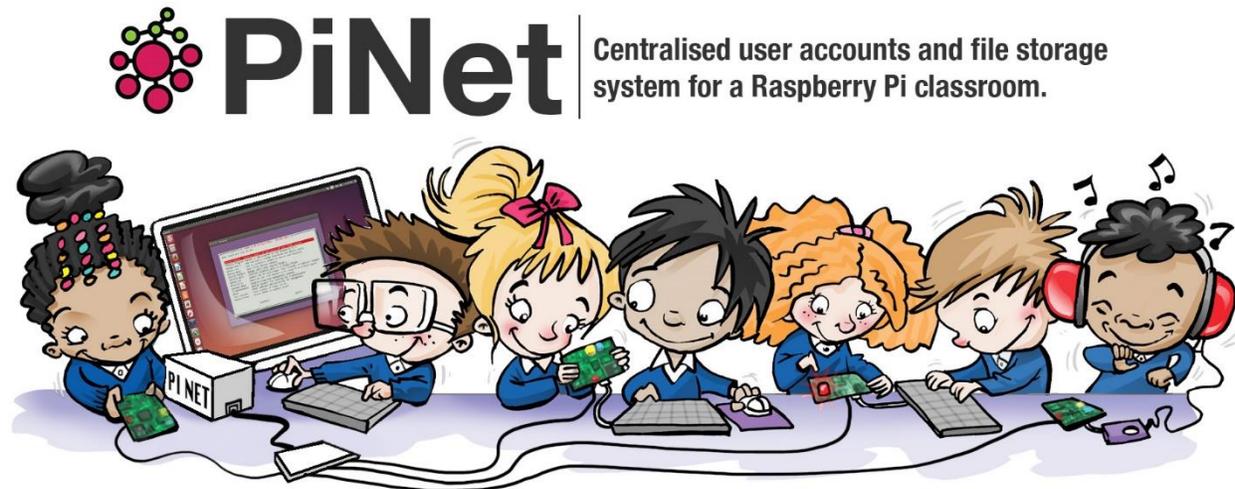
Python is a dynamic programming language that programmers express their code with fewer lines than any other coding language [15]. Python supports the C language and java syntax [15]. Through python girls could learn how to code and create projects that could help them develop their countries. Installing python on raspberry pi requires simple steps as shown below [19]:

- Write these commands on the terminal: sudo apt-get update / sudo apt-get install python3
- Since Raspbian is the operating system, these two command will allow python to be updated. Write sudo apt-get update and sudo apt-get upgrade

### 3.2.2 PiNet Application

PiNet is a free project that helps schools and students to have a raspberry pi classroom. It has been developed from qualified teacher with responses from different countries around the world [20]. The main futures are any student can use any raspberry pi and login with his username and password. It shares folders easily between teachers and students. A work collection system, where students can submit their work online. PiNet systems automatically back up all student files to a special drive and acts like a server [20]. PiNet application would help save money and provide an organized teaching plan. Each raspberry pi needs its own SD card, with PiNet

students are not required to have their own SD cards.



**Figure 9: PiNet Classroom [20]**

### 3.2.3 LibreOffice and PDF Reader

LibreOffice is a free document application that supports Microsoft office files. LibreOffice can do word processing, PowerPoints, spreadsheets, formulate a formula with Math, and other educational software's. LibreOffice will allow students to write reports or do presentations for school assignments. There are simple steps to install LibreOffice on the Raspberry pi.

- Install Pi Store - `sudo apt-get update && sudo apt-get install pystore`
  - Afterward open Pi Store and download Libre office
- OR
- Open the terminal on raspberry pi simply type `sudo apt-get install libreoffice`

## 4.0 Budget

The budget is divided into two parts, the tablet requirement and the power requirement.

**Table 4.0: Tablet and Power Budget**

Part #	Item	Company	Quantity	Cost	Part description
1	Raspberry pi 3 Model B	raspberrypi.org	1	\$35	Low cost small size computer
2	Touch screen	Adafruit.com	1	\$35	2.8" 320X240 16-bit color pixels
3	32 GB SD card	Micro SD	1	\$10	
4	Battery	Gadgets360	1	\$10	Input: DC 5.0V/2.0A Output:DC5.0V/1A,5.0V/2.0A Capacity: 10000mAh Productize:92.2mmx60.2mm
5	Solar Charger	E-Bay	1	\$10	Input: 5V 1A Output:5V 2A Wieght:145g Capacity:12000mAh
6	Medium 6V 2W Solar panel - 2.0 Watt	Adafruit.com	1	\$29	A panel that is waterproof. They use a high efficiency monocrystalline cell. They output 6V at 330 mA via 3.5mm x 1.3mm DC jack connector
7	USB / DC / Solar Lithium Ion/Polymer charger - v2	Adafruit.com	1	\$18	This charger is a very unique design, perfect for outdoor projects, or DIY iPod chargers
8	Lithium Ion Polymer Battery - 3.7v 2500mAh	Adafruit.com	1	\$15	Lithium ion polymer batteries are thin, light and powerful. The output ranges from 4.2V when completely charged to 3.7V. This battery has a capacity of 2500mAh for a total of about 10 Wh.
9	DC Jack Adapter Cable	Adafruit.com			
10	PowerBoost 500 Basic - 5V USB Boost @ 500mA from 1.8V+	Adafruit.com	1	\$10	DC/DC boost converter module can run from 1.8V batteries or higher, and convert that voltage to 5.2V DC for running your 5V projects
<b>Total</b>				<b>\$172</b>	

## **5.0 Discussion**

Q8 engineering team with this project have benefit the communities that lack education access.

The main goal is to have a raspberry classroom that students could learn and gain knowledge for lifelong time. Each student will have a raspberry pi tablet that is powered through solar panel.

This project will increase the income of the developing countries by having more jobs for teacher to teach students. The applications implemented on the raspberry pi will cause students to have access to online classes and distance learning. In rural areas, it's hard to find teachers, with this technology, student can have access to education from all the world.

## **6.0 Conclusion and Future Recommendation**

Raspberry Pi is a mini computer designed with the capabilities of a normal personal computer that enables schools/institutions to train students. Raspberry Pi Foundation developed the board in the United Kingdom with the aim of increasing the number of computer literates. The hardware can be used for a lot of things, ranging from project solving, computer challenges, prototyping and software testing among many other applications [21]

In most cases, Raspberry Pi is used for education purposes. Trainers normally tutor the students and challenge them to design something related to the subject in question. Through challenging competitions and problem-solving projects, the board is widely used for computer learning. A good example is a simple object recognition system that identifies and separates metals from plastics.

Schools can also organize for same age competitions in the earlier lower levels of learning. It has been proved that competitions normally inspire students and increase their innovativeness. This

is highly recommended as students will be more acquainted with the skills to handle and create projects that may commercially sell.

Raspberry Pi can also be used for data logging device. A data logger is another smart device that keeps data about the geographical location with the help of sensors. Since the Raspberry Pi device is a special computer in its way, it can be used as a data logger. The Raspberry Pi board can be powered with a dc battery source and added some external devices and sensors. The microprocessor and data storage that are also necessary are already available on the device. For example, one can write a program to log temperature. One can then create a graphical user interface (GUI) that enables one to select the kind of data to measure.

Remote controlling with Raspberry is very much possible as a step towards obtaining effective system controlling [22]. By installing Team Viewer in raspberry, one can achieve remote desktop control. One needs to find the linked password and login and includes them in PC. Alternatively, VNC can give you access to another desktop PC [33]. This can be made possible by ensuring that the personal computer and Raspberry are located in the same local area network. High-end applications Raspberry can be used in robotic systems [24] and high-end control. The microcontroller is normally used to control robots by loading code that coordinates the various motions and coordinate axis. By so doing the hardware can be used for robot applications.

Raspberry pi could resolve the problems facing girls around the world. In this project, girls could learn and improve their math and science skills. The project has many advantages with respect to the budget and the overall gain each girl could take.

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