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## Internet of things security module using Raspberry Pi in an examination room

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### ABSTRACT

Examination occupies a very strategic role position in our lives both in education and industries. Teachers, lecturers and counsellors rely on them for a comprehensive evaluation of their students and clients. In industries, experts in human relations and employment bureaus utilize tests in reaching a decision as to the employment of an individual. Despite the importance of examinations or test-taking for diagnostic placement, classification and quality control in Ugandan institutions, the integrity and credibility of public examinations have been eroded and corrupted with increasing incidences of examination malpractices. Internet of Things security is a project that brings an idea to schools and institutions to improve the examination security monitoring level and too the engineering role in society. As engineers, all we need to do is to come up with possible solutions to deal with the problem. There has been rampant malpractice around the globe in schools which has brought us the attention to think and innovate; using raspberry pi the mini-computer to store data and to run programs which brings the need tackled. One can use his laptop, desktop, or mobile phone to access and use it to see what is happening. It can store data say Student databases, and results, among others. The camera can be used for taking pictures and videos as the fingerprint does the biometric authentication, and with these, we can curb the rampant act of exam malpractices.

Keywords: Examination, Education and Industries, Employment, Students, Institutions.

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### INTRODUCTION

The Internet of Things (IoTs) can be described as connecting everyday objects like smartphones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves [1]. The development of the Internet of Things has revolutionized a number of sectors, from automation, transportation, energy, healthcare, and financial services to nanotechnology. IoTs technology can also be applied to create a new concept and wide development space for smart security to provide intelligence, and comfort and to improve the quality of education as designed in our project to curb the act of examination malpractices in schools. As witnessed from the past, most African schools or institutions like Uganda are facing the problem of rampant exam malpractices or conflicts with students and invigilators [2]. Although some are caught, there are many who survive due to improper security monitoring system during the examination periods. Mere having mobile invigilators to and fro along the room might not be enough to prevent examination malpractices. This raises questions on whether the examinations were conducted well or not. Examination malpractice is any illegal act committed by a student single handled or in collaboration with others like fellow students, parents, teachers, supervisors, invigilators, printers and anybody or group of people before, during or after examinations in order to obtain undeserved marks or grades. It can also be defined as an unconventional or unlawful ways that learners use in passing their tests or exams. Academic malpractices are on increase across the world and this is a threat to the society and public trust in reliability and credibility [3-5]. There are very many forms of exam malpractices including; Impersonation where an individual who is not registered as a candidate for a particular examination takes the place of one that is registered. Usually this involves collusion between the chief examiner and the examination supervisor. It frequently involves tertiary institutions students taking the test for monetary reward or a favour for a girlfriend or boyfriend. There is also smuggling of foreign

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materials, perhaps the most common form of malpractice. It relates to the introduction of unauthorized materials (e.g. parts or whole notebooks, text books, microchips and answers) into the examination hall. Foreign materials are frequently smuggled in pants, shoes, hems and bras or deposited or fixed in the hall prior to the examination or even smuggled in by the candidates or their aids during the examination. Another is copying from another candidate's work with or without permission. [6-9]

There is Collusion i.e. unauthorized passing of information between candidates usually by exchanging notes or scripts. This is usually facilitated by inadequate spacing between desks and relaxed supervision. Due to this, here we have designed a reliable supervisory system to curb examination malpractices using raspberry pi [10].

Solar photovoltaic energy can also be used for backup energy for steady and efficient IoT delivery. The major review, development and optimization has been done on how to use renewable energy option in photovoltaic to supplement the conventional energy supply [11-20]

### Statement of problem

Despite several studies conducted on examination malpractices, the vice continues and seems to be on increase. Year after year, the press comes up with the statement about examination malpractice but the act still continues which lowers confidence in our education system. This project thus addresses the reliable supervisory way of curbing the rampant examination malpractices within the room.

### Aim

To design an effective and reliable security monitoring module using raspberry pi in an examination room so as to curb the problem of examination malpractice.

### Specific objective

- To configure the fingerprint reader which is to be used for identification of the candidate so as to avoid impersonation where an individual who is not registered as a candidate for a particular examination takes the place of one who is registered.
- To also configure the webcam to carry out the snap shooting and video streaming within the room so as to provide a witness stand in terms of a streamed video exam to check conflicts, smuggling of foreign materials, copying from another candidate's work with or without permission etc.

### Research Questions

- I. Can the configuration of fingerprint be used for the identification of the candidate so as to avoid impersonation?
- II. Does configuration of the webcam carry out the snap shooting and video streaming within the room so as to provide a witness stand in terms of a streamed video exam to check conflicts, smuggling of foreign materials, copying from another candidate's work with or without permission etc?

### Significance of the Study

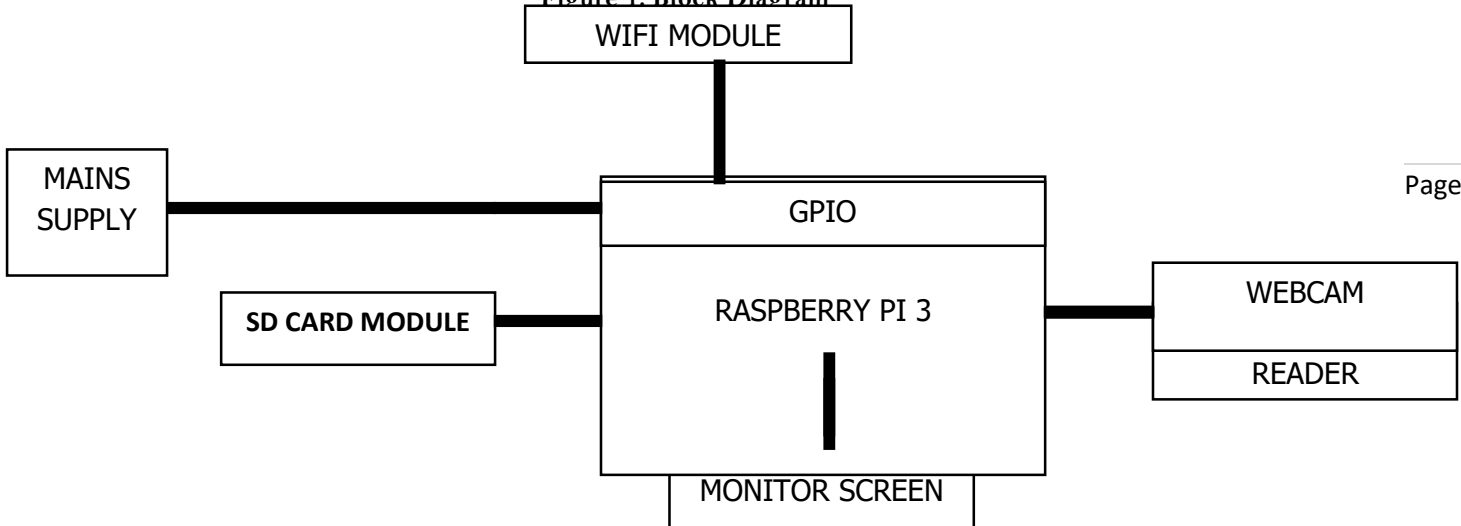
The project is cost-effective, multipurpose and easy to use during the monitoring and supervisory system in examination periods. This would help build confidence in our education system by producing graduates of substance who will in turn contribute effectively to the economic development of our country.

### METHODOLOGY

#### The Block Diagram of the Design

The block diagram below shows that how the system operates in an examination room. The hardware design consists of raspberry pi, finger print sensor, wifi module, webcam, VGA monitor, SD card module among others.

Figure 1: Block Diagram



**Connecting Everything Together**

- Plug the preloaded SD Card into the Raspberry pi.
- Plug the USB keyboard and mouse into the Raspberry pi, perhaps via a USB hub. Connect the Hub to power, if necessary.
- Plug a video cable into the screen (TV or monitor) and into the Raspberry pi.
- Plug the extras into the Raspberry pi (USB WiFi, Ethernet cable.). This is where we needed a USB hub.
- Ensure that the USB hub and screen are working.

Once we have programmed the SD Card – plug it into the Raspberry Pi, we now have a configuration looking like this:

Figure 2: First Boot



- Plug the power supply into the mains socket.
- With the screen on, plug the power supply into the Raspberry pi micro USB socket.
- The Raspberry pi should boot up and display messages on the screen.

It is always recommended to connect the Micro USB power to the unit last (while most connections can be made live, it is best practice to connect items such as displays with the power turned off). The Raspberry pi may take a long time to boot when powered-on for the first time, so we had to be patient!

### Software used

NOOBS is a way to make setting up a Raspberry Pi for the first time **much, much easier**. You won't need network access, and you won't need to download any special imaging software [12][14][17][21]. Just head to the downloads page, grab a copy of the NOOBS zip file, and unpack it onto a freshly formatted 4GB (or larger) SD card. When you boot up for the first time, you'll see a menu prompting you to install one of several operating systems into the free space on the card [15][19][22][23-30]. The choice means you can boot the Pi with a regular operating system like Raspbian, or with a media-center specific OS like Rasp BMC.

Figure 3: Installing raspbian using Noobs



Once you've installed an operating system, your Pi will boot as normal. However, NOOBS stays resident on your card, so by holding shift down during boot you can return to the recovery interface [23]. This allows you to switch to a different operating system, or overwrite a corrupted card with a fresh install of the current one. It also provides a handy tool to let you edit the config.txt configuration file for the currently installed operating system, and even a web browser so you can visit the forums or Google for pointers if you get stuck [24][13][16][18][31-39].

### Configuring the pi

Sudo raspi-config

When in setup mode we had to:

Re-size to file-system to use the entire SD card in our case (8GB)

First option in setup menu.

Change the locale to match raspberry pi location.

This is found under "Internationalization Options"

Change the time zone to match our location.

This is found under "Internationalization Options"

### Installing GPIO Zero

GPIO Zero is installed by default in the Raspbian image, and the Desktop image for PC/Mac, both available from raspberrypi.org. Follow these guides to installing on Raspbian Lite and other operating systems, including for PCs using the remote GPIO feature.

First, update the repositories list:

```
pi@raspberrypi:~$ sudo apt update.
```

Then install the package for Python 3:

```
pi@raspberrypi:~$ sudo apt install python3-gpiozero.
```

### Webcam

Rather than using the Raspberry Pi camera module, we used a standard USB webcam to take pictures and video on the Raspberry Pi. Note that the quality and reconfigurability of the camera module is highly superior to a standard USB webcam.

#### Installing webcam

First, install the fswebcam package: `sudo apt-get install fswebcam`.

Enter the command `fswebcam` followed by a filename and a picture will be taken using the webcam, and saved to the filename specified:

```
fswebcam image.jpg.
```

This command will show the following information:

```
--- Opening /dev/video0...
```

```
Trying source module v4l2...
```

```
/dev/video0 opened.
```

```
No input was specified, using the first.
```

```
Adjusting resolution from 384x288 to 352x288.
```

```
--- Capturing frame...
```

```
Corrupt JPEG data: 2 extraneous bytes before marker 0xd4
```

```
Captured frame in 0.00 seconds.
```

```
--- Processing captured image...
```

```
Writing JPEG image to 'image.jpg'.
```

#### Recording a video

To record a video, enter the command below

```
fswebcam image.mov.
```

#### Installing vlc to play video.

```
sudo apt-get install vlc.
```

#### Installing Library for Finger Print Sensor

After making all the connections we need to power up Raspberry Pi and get it ready with terminal open. Now we need to **install fingerprint library for Raspberry Pi** in python language by following the below steps.

**Step 1:** To install this library, root privileges are required. So first we enter in *root* by given command `sudo bash`.

**Step 2:** Then **download some required packages** by using given commands:

```
wget-0 - http://apt.pm-codeworks.de.gpg/ apt-keyadd-
```

```
wgethttp://apt.pm-codeworks.de/pm-codeworks.list -p/etc/apt/sources.list.d/
```

**Step 3:** After this, we need to update the Raspberry pi and install the downloaded finger print sensor library:

```
sudo apt-get update.
```

```
sudo apt-get install python-fingerprint -yes.
```

## RESULTS

### System design and analysis

As shown in the block diagram above, the hardware design consists of raspberry pi, finger print sensors, wifi module, webcam, VGA monitor and SD card module. The raspberry pi is powered by use of a micro USB adapter that can provide 5V and at least 700mA of current the mains. The raspberry pi is expected to boot up providing up files using the SD card used. All the operations or the activities that the pi does are expected to be shown onto the monitor screen which are later set to the android by use of wifi module. As the candidate is entering to sit for an exam, he first verified or identified by use of the fingerprint scanner. The webcam is then set to capture the image of the candidate and then stores it in the SD card used. After the entry process is done, the webcam is then set to stream the video live to another monitor or android to see what clearly is taking place in the examination room. Streaming continues until the exam gets done and this is stopped by the authorized android user.

## DISCUSSION

Most African schools or institutions like Uganda are facing the problem of rampant exam malpractices or conflicts with students and invigilators. Although some are caught, there are many who survive due to improper security

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monitoring systems during the examination periods. Having mobile invigilators to and fro along the room might not be enough to prevent malpractice. Due to this, we have come up with an effective way of reducing the activity. This also provides a witness stand due to the video streaming done during the examination period.

#### Challenges faced

Among the challenges we faced was programming the pi beyond. We have also faced a challenge of materials since we had to order online the stuff. This means that time was shortened and the pi required time to be programmed and focus on the best quality. However, we thank God we managed to do something.  
the same time.

#### CONCLUSION

Having had a thoroughly research about the project, our anticipation is far clear that it is to be beneficial. It improves the security monitoring level by use of the webcam and other attached credentials of snap shots and finger print. We expect that this will reduce the problem of examination malpractices more especially within the examination room.

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