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## Harnessing HTML5 Web Technology: An Alternative Means for Mobile e-Reporting in Developing Countries.

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### ABSTRACT

Abstract— With the proliferation of affordable mobile devices like smartphones, PDAs and tablets in developing countries, there arises a critical opportunity for news media outlets to harness these devices to enhance organised news collection and dissemination. Focused on Nigeria as a case study, this article investigates the utilization of mobile and web technologies to establish an efficient system for reporters to gather and transmit multimedia data from remote villages, even in areas with limited or no internet connectivity. Designing a hybrid mobile application developed with a blend of HTML5, CSS, and JavaScript, this study ensures accessibility across various devices, from feature phones to smartphones, through standard web technology. By embracing a cross-platform approach, the aim is to mitigate potential challenges associated with delays or disruptions in news delivery due to factors such as social unrest, criminal activities, or government interventions. This research underscores the significance of leveraging technology to bridge gaps in news dissemination, particularly in regions facing infrastructural limitations and socio-political instability.

**Keywords;** e-Reporting, Journalist, Reporters, Editors, HTML5, Hybrid, MoJo, Multimedia, Cross-Platform, Multi-Platform.

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### 1. INTRODUCTION

Reporting is a type of journalism that involves the conceptual gathering of information and assembling it into a collection of facts surrounding an event for presentation as news to an audience [1]. Although the terms "reporter/reporting" and "journalist/journalism" are used synonymously in this study, there is a slight difference in their actual meanings. Journalism, on the other hand, entails the investigation and analysis of news content with balanced commentary to provide insight. In essence, journalism is a more comprehensive form of expository reporting [2].

The development of modern journalism, characterized by the investigation and collection of multimedia news content, evolved in the 20th century. Initially reliant on cumbersome tripods and light-dependent cameras, reporters captured images of events, often tethered to a single location [3]. However, as noted by Medoff et al. [4], the relentless advancement of Telecommunication and electronic media technology, encompassing audio recorders, photography, and video cameras, revolutionized news gathering. This evolution empowered journalists to compile news content from diverse locations within an event and transmitting to the base station in real-time, enhancing the breadth and depth of coverage. However, due to the challenges posed by inadequate telecommunication infrastructure in developing countries as shown in a study by [5], this is not the prevailing scenario for many news media outlets within these regions. Despite the trend towards presenting news content in multimedia formats, logistical hurdles persist. Multimedia files are primarily stored within electronic devices or external storage mediums. Transmitting these materials to news media outlets or editorial teams often necessitates physical delivery by reporters, utilizing various forms such as tapes, films, external hard drives, written notes, flash drives, disks, or cassettes.

Today, the landscape of news gathering is rapidly evolving alongside the relentless progress of Information Communication Technologies and mobile technologies. As these electronic devices continue to shrink in size and expand in capabilities, both professional mobile journalists, often referred to as MoJos [6], and members of the public functioning as citizen journalists, are harnessing a myriad of communication tools to collect and disseminate news content. This includes a diverse array of equipment such as online digital cameras, laptops, wireless internet modems, GPS devices, emails, and smartphones. These portable and sophisticated devices empower journalists and citizen reporters alike, enabling them to gather information swiftly and deliver news content efficiently in developed nations like the United States and the United Kingdom. [7]



Figure 1.1: Comparison of Journalist Accessibility in Crowded Environments Using Traditional Equipment and Smartphones [8].

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However, this cannot be said for reporters in developing countries, where the adoption of technological advancements in communication has not been significantly utilized. Although technologies such as emails, computers, and portable storage drives have been adopted by some reporters in Nigeria, most content is still delivered physically with equipment to the news media.

Furthermore, a considerable amount of news content fails to reach the news media either in time or at all. This is primarily attributed to factors such as growing terrorism, tyrannical governments, and states of emergency. An illustrative example of this is when police, military, or terrorists confiscate reporters' cameras or recorders and destroy them or delete news content, as witnessed in the case of Aliyu and Musa [9] who, in December 2012, had their reporting equipment seized and their contents erased.

This study will employ the concept of enabling mainstream reporters to operate covertly and attract less attention, thereby enabling the transmission of news multimedia with minimal delay before any potential loss or seizure of equipment. This objective can be accomplished by effectively leveraging mobile e-reporting in developing countries, particularly in Nigeria, where the use of mobile phones and GSM mobile networks to access the internet is experiencing exponential growth [10].

### **1.1 Mobile Technology Driving e-Reporting**

Mobile electronic reporting, often referred to as e-reporting is the use of mobile devices, such as smartphones, to send or receive news content in electronic multimedia formats. With modern mobile technologies now equipped with text, audio, image and video capturing capabilities, GPS access, internet connectivity, and stable operating systems, they have become essential tools for reporters to collate and transmit news content [11]. A study by Antonopoulos et al. [12] found that traditional media outlets in the UK and US, such as Sky News, CNN, and Al Jazeera, extensively utilize mobile platforms to obtain news content from citizen reporters (crowdsourcing), enabling them to cover locations that are inaccessible to their professional reporting teams.

Mobile technologies encompass a range of portable devices, including smartphones, laptops, PDAs, and tablets. These devices are equipped to utilize various communication technologies such as GPRS, Wi-Fi and internet data services. Central to their functionality is the operating system (OS), a critical component facilitating the operation of applications, APIs, and hardware components.

Research by Okediran et al. [13] identifies major mobile operating systems as Android, iOS, Windows, Symbian, and BlackBerry OS, all instrumental in facilitating the execution of applications widely embraced by mainstream media. These operating systems provide access to both native and web applications, empowering reporters to leverage the full spectrum of their device's features for gathering multimedia news content. Furthermore, findings from Žišková [14] indicate that social media applications, including chat platforms, have emerged as a favourite among journalists in the field, further enhancing their ability to gather and disseminate news efficiently.

**1.2 The Challenges of Mobile e-Reporting in Developing Countries.**

Reporters in many developing countries may not have the privilege of taking advantage of mobile technologies for reporting multimedia content. Developing countries are still in the process of development, including their communication technologies and infrastructures. Government regulation and monitoring of the internet pose a major obstacle for mobile e-reporting in many African countries, such as Tunisia [15]. Other challenges include inadequate infrastructure, particularly poor road networks, fuel scarcity, and erratic telecommunication services in nations like Nigeria. The unreliable or intermittent electricity supply, with frequent power outages due to factors like poor maintenance and vandalism, is also an obstacle [16].

The use of inexpensive or obsolete mobile devices with a lack of access to state-of-the-art technology due to budget constraints hinder effective reporting [17]. Limited connectivity in remote areas and terrorism impacting telecommunication infrastructure exacerbate the poor internet infrastructure situation [18]. Additionally, the level of information technology literacy among reporters, particularly in rural areas, challenges the adoption of mobile e-reporting. Addressing these challenges is crucial for successful mobile e-reporting implementation in developing countries.

**1.3 The Rapid Expansion of Affordable Mobile Devices in Developing Nations.**

In Africa, a considerable portion of mobile phone users still rely on feature phones. Feature phones, characterized by their affordability, simplicity, and basic functionality, lack the advanced capabilities of smartphones and are primarily utilized for voice calls, text messaging, and limited web browsing, without the ability to download applications from online markets [19]. In contrast, smartphones integrate the functionalities of both a phone and a computer. Recent research [20] indicates a notable surge in smartphone adoption across Africa, accompanied by a gradual decline in the usage of feature phones. However, it is important to note that a significant segment of the population in developing countries, particularly in rural areas, continues to rely on feature phones or inexpensive smartphones due to factors such as affordability and accessibility.

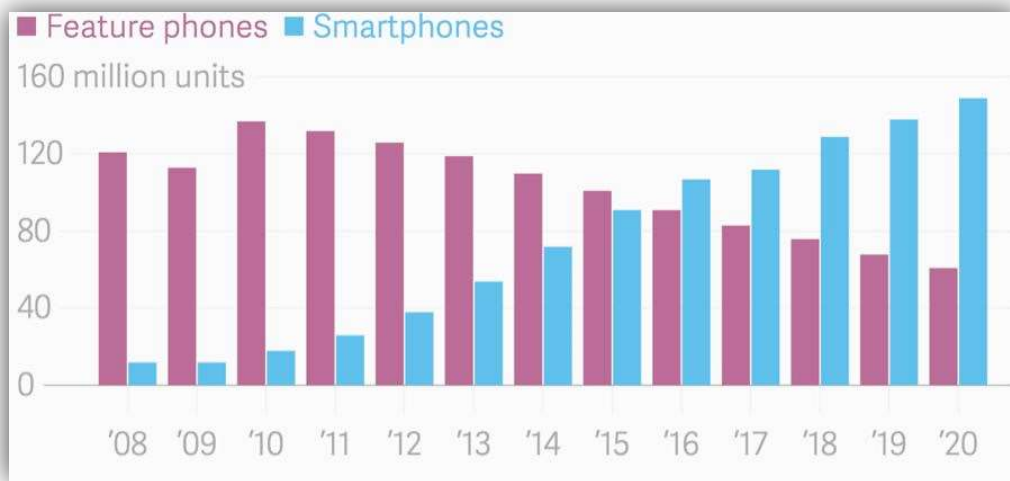


Figure 1.2: Annual Mobile-Phone Shipments in Africa from 2008 to 2020 [20].

The transmission of compiled multimedia news content from reporters to the News Agency can occur via physical delivery or through internet connectivity. Omotayo B, in an article for Business Day Nigeria [21], highlights the increasing accessibility of internet services in Sub-Saharan Africa, with a significant rise of 71% in internet users. This surge suggests a broader dissemination of internet services, particularly in rural areas, predominantly facilitated by GSM network providers.

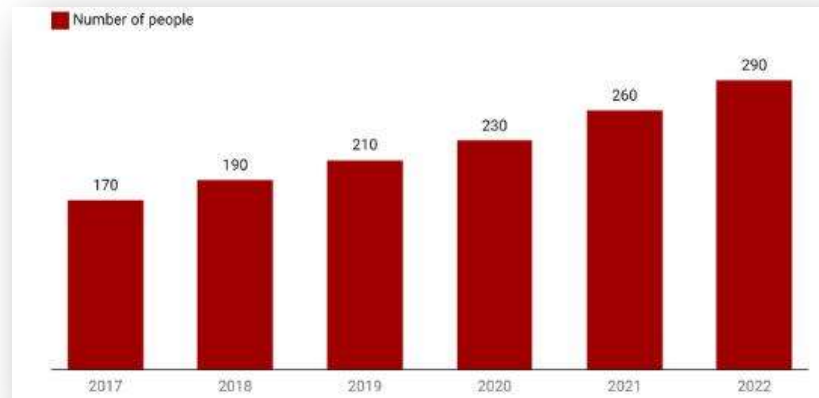


Figure 1.3: Annual Mobile-Internet User in Sub-Sahara Africa from 2017 to 2022 in Millions [21].

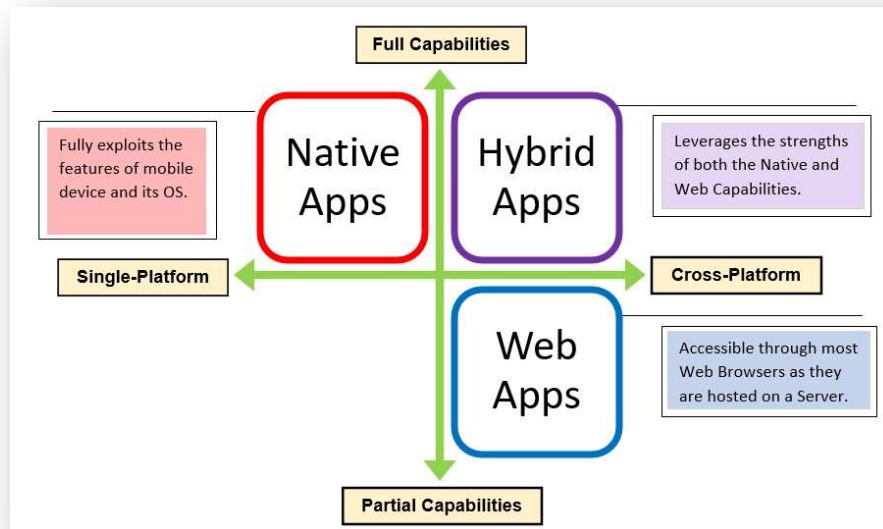
The increasing accessibility of internet services and mobile devices in developing nations, particularly in sub-Saharan Africa, presents a significant advantage for reporters who need to efficiently transmit multimedia news content using their available mobile devices. Unlike traditional methods, this approach does not necessitate a constant power supply, robust internet connectivity, sophisticated devices, or well-developed infrastructure such as good roads for transporting bulky equipment.

**2. A SOLUTION: MOBILE APPLICATIONS DEVELOPMENT APPROACH.**

The challenges faced by many reporters in developing countries in utilizing mobile technology cannot be addressed with a one-size-fits-all solution. However, this study intends to mitigate some of these problems from the mobile application development perspective. We must first examine the three standard taxonomy approaches to developing mobile applications, as described in [22]. Native applications are built using platform-specific programming languages and tools. This implies that an application developed for an Android mobile device cannot be seamlessly transferred to an iOS device. The primary challenge with native applications lies in the necessity to recreate the same mobile application in the programming language suitable for different mobile operating systems. Despite this challenge, native applications offer the best user experience, as they can fully exploit the features of both the mobile device and its operating system. Web applications, on the other hand, are cross-platform applications accessible through most web browsers as they are hosted on a server. However, these applications rely on internet connectivity for both access and speed.



Additionally, they have limited control over mobile device features, particularly in terms of multimedia control [14]. Hybrid applications, meanwhile, leverage the strengths of both native and web applications as described in a study by [23]. They are developed using web development programming languages and then encapsulated within a native container to ensure full access to all features native to the mobile device and operating system. Hybrid applications offer cross-platform compatibility and do not rely on internet connectivity.



**Figure 2.1: The Three (3) Standard Taxonomy Approaches to developing Mobile Applications.**

In summary, the development of a mobile e-reporting application tailored for reporters in developing countries necessitates a solution that enables seamless capture and reporting of multimedia content while minimizing conspicuousness. Such an application must be easily accessible and adaptable to a diverse range of mobile devices, encompassing both smartphones and feature phones commonly used in rural areas. Native applications offer unparalleled user experiences but are hindered by platform specificity, requiring extensive development efforts and financial resources to cater to various platforms. On the other hand, web applications offer cross-platform accessibility but are reliant on stable internet connections and often lack control over device functionalities, posing challenges for reporters operating in remote locations with limited connectivity.

Hybrid applications emerge as a compelling solution, amalgamating the strengths of native and web approaches. By leveraging the versatility of hybrid applications, reporters can effectively overcome issues related to poor internet connectivity and device compatibility while harnessing the full spectrum of device features for multimedia content collection and collation. The hybrid approach presents an optimal solution for addressing the unique challenges faced by reporters in developing countries. By seamlessly integrating the advantages of native and web technologies, hybrid applications empower reporters to fulfil their journalistic duties efficiently, irrespective of their geographical location or the constraints of their mobile devices.

## 2.1 Capabilities and Features of an HTML5-Based Hybrid Mobile Application for Multimedia e-Reporting.

Hybrid mobile applications leverage various programming languages and frameworks, but HTML5 stands out as the preferred approach, often combined with CSS and JavaScript. Utilizing a WebView component, hybrid mobile applications can execute HTML, CSS, and JavaScript code within a browser engine embedded in the app [24]. This setup enables the integration of web technologies seamlessly into mobile applications, offering cross-platform capabilities. While newer frameworks like React Native, Flutter, and Xamarin gain popularity, HTML5 remains a prevalent choice due to its versatility and utilization of web development skills, as noted in a comparative study by You et al. [25]. This study focuses on the cross-platform and multimedia capabilities of HTML5, especially in addressing diverse mobile operating systems and devices prevalent in developing countries. HTML5's widespread adoption across modern web browsers empowers developers with a rich set of tools for building hybrid mobile applications tailored for e-reporting.

HTML5 boasts several features that make it particularly suitable for developing hybrid mobile applications for multimedia news content e-reporting in developing countries:

1. **Advanced Features and APIs** : HTML5 introduces advanced features like the <canvas> element for graphics rendering and the <video> and <audio> elements for multimedia playback. Additionally, it provides APIs for geolocation and local storage, enhancing the functionality of mobile applications.
2. **Enhanced Forms** : HTML5 simplifies form validation and user input handling with new input types such as date, email, and number, along with attributes like required, pattern, and placeholder, streamlining the user experience.
3. **Support and Compatibility** : HTML5 maintains backward compatibility with older HTML standards while enjoying robust support from modern web browsers. Although some features may not function on outdated browsers, HTML5 features excellent compatibility with contemporary browsers.
4. **Rich Media and Multimedia** : HTML5 reduces reliance on third-party plugins like Java Applets, Adobe Flash, or Microsoft Silverlight. Its native support for multimedia elements allows seamless embedding and manipulation of multimedia content directly within web pages.

In summary, HTML5's strong support, compatibility, multimedia capabilities, geolocation support, and local storage functionality make it an ideal choice for developing e-reporting mobile applications in developing countries. By harnessing HTML5's features and capabilities, these applications can effectively address challenges faced by reporters and journalists in accessing and disseminating information.

## 3. RELATED WORKS

Numerous studies have investigated the capabilities of utilizing mobile devices for electronic news reporting. Mabweazara's study [26] highlighted the widespread adoption of mobile phones in Africa, enabling reporters and journalists to overcome localized obstacles encountered in the field. In Indonesia, Prestianta [27] examined how reporters from a news outlet utilized smartphones and social media to gather, produce, edit, and disseminate multimedia news content.

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The research revealed that the adoption of mobile devices for mobile journalism among reporters was relatively new, yet as deemed mandatory, it significantly enhancing journalist productivity. Mills et al. [28] emphasized the need for a streamlined mobile application platform and methodology to facilitate improved multimedia content capturing methods for professional reporters and students in conflict communities through collaboration. Additionally, Dodds [29] demonstrated how reporters utilized a mobile chat application to enhance the collation and dissemination of news content while fostering trust between reporters and event sources, as evidenced in two Chilean newsrooms. Many of these studies on mobile applications used by reporters to collect, collate, and transmit news content focus on applications that can handle one or a few multimedia contents at a time, rather than a comprehensive solution.

Mainstream news media outlets in developed countries have responded by developing streamlined mobile applications for news media e-reporting, often through collaborations or citizen journalism initiatives. These applications aim to receive news multimedia content from citizens or Mobile Journalists (MoJos) who are present at events before traditional journalists and equipment arrive. This approach also allows newsrooms to gather content from locations inaccessible to their own journalists. For instance, CNN's 'iReport' platform enables the public and journalists to register and submit multimedia content from various parts of the world via their web mobile application, which undergoes vetting before broadcast [30]. Similarly, The Guardian has developed the "Guardian-Witness" native mobile app, facilitating the submission of multimedia content such as sound, pictures, videos, and text with a single click [31]. The BBC's 'Your Story' mobile web application platform allows users to submit news stories and content for potential use in BBC News broadcasts or online articles [32]. Other mainstream applications, such as Al Jazeera's 'Witness' platform, NBC News' 'iWitness' platform, and Fox News' 'uReport' platform, offer similar functionalities, as noted by Wall [33].

The current streamlined mobile applications owned by mainstream media outlets, often overlooks the unique challenges encountered by reporters in developing nations. Mainstream media platforms, whether web or native, are frequently designed without consideration for the constraints posed by lower-end mobile devices and unreliable internet connectivity prevalent in these developing countries. Traditionally, these platforms have favoured responsiveness, leading to the utilization of HTML5 for mobile web applications due to its widespread compatibility across modern browsers. However, this approach fails to address the specific cross-platform and multiplatform needs of journalists operating in resource-constrained environments. While hybrid mobile applications, which seamlessly integrate web technologies with native functionalities, have not been extensively leveraged for news media e-reporting in developing countries, they have demonstrated effectiveness in other fields of e-reporting. This underscores the potential for hybrid solutions to bridge the gap and better serve the needs of news reporters operating in challenging contexts.

Hybrid mobile applications, renowned for their cross-platform versatility, have found widespread adoption across developing and developed countries. An assessment conducted on two 'Virtual Campus' hybrid mobile applications designed for a university in Romania, as outlined in a study by [34], leveraged the cross-platform and multi-platform capabilities of the hybrid application. This approach made the mobile applications accessible to students, particularly considering the heterogeneity of mobile devices, operating systems, and internet access conditions.



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Additionally, a research by [35] explored the potential of HTML5 as the future of mobile e-health application development for monitoring diabetes. However, the focus of this study is not on the types of mobile applications used in developing countries. Instead, it aims to explore the potential of hybrid mobile applications, especially those built with HTML5, in enabling reporters in remote areas, particularly in developing countries, to collate and collect multimedia news content. The study takes advantage of the capabilities of hybrid mobile applications in overcoming challenges faced in these regions, such as the ability to function offline or with intermittent internet connectivity, cost-effectiveness, and adaptability to diverse device types. By building a single application that can be packaged for various platforms, the development process is streamlined, reducing costs.

In context, this study is not focused on the type of mobile applications used in developing countries. The aim is to explore the hybrid mobile applications, especially built with HTML5 in enabling reporters in remote areas especially in developing countries to be able to collate and collect multimedia news content by taking advantages of the hybrid mobile applications capabilities in overcoming some of the challenges faced in these countries, such as; the ability for the mobile application to work function offline or with intermittent internet connectivity, and cost effectiveness and adaptability to divers number of devices as the application can be built once and packaged for all types of platforms which reduces cost.

The adoption of a hybrid approach tailored to the unique challenges faced by reporters in developing countries can empower them to efficiently capture and transmit multimedia content, regardless of their geographical location or the limitations of their mobile devices. This, in turn, can enhance the dissemination of news and information from these regions, fostering greater access to information and enabling more diverse narratives to be shared.

#### **4. METHODOLOGY**

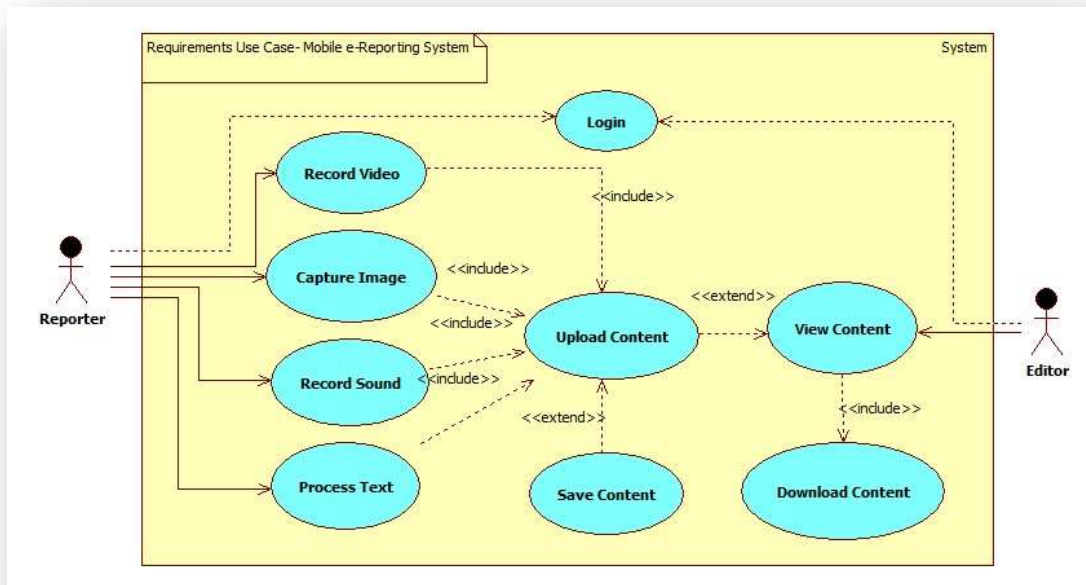
This study aims to explore the capabilities of HTML5 in design a hybrid mobile application for e-reporting that addresses the unique challenges faced by reporters, particularly in developing countries. A prototype will be designed to harness the potential of HTML5-based hybrid applications in efficiently capturing, collating, and delivering multimedia news content to respective news editors. The methodology will involve a comprehensive analysis of the specific requirements by reporters in remote or underdeveloped regions, such as intermittent internet connectivity, limited device capabilities, and resource constraints. By leveraging the cross-platform compatibility and offline functionality offered by hybrid applications, the prototype will strive to provide a robust and accessible solution for multimedia e-reporting.

The development process will focus on optimizing the user experience and streamlining the workflow for reporters, enabling seamless capture and transmission of multimedia content, including text, images, audio, and video. Additionally, the study will examine the potential for integrating advanced features, such as real-time collaboration, location tracking, and secure data transmission, to further enhance the utility of the application. Through an iterative analysis and design approach, the prototype will be evaluated and refined to ensure its effectiveness in overcoming the identified challenges.

Ultimately, this study aims to contribute to the body of knowledge on leveraging hybrid mobile application development, particularly with HTML5, to empower reporters in disseminating news and information from remote or underdeveloped regions, fostering greater access to diverse narratives and contributing to the democratization of information.

**4.1 The e-Reporting Hybrid Mobile Application Systems Analysis & Design.**

The proposed e-Reporting mobile application aims to address the fundamental needs of reporters and journalists operating in the field. The development process will involve the establishment of concise and effective functional requirements, as illustrated in the use case diagram (Figure 4.1). Simplicity in the operations of the hybrid mobile application system is crucial, enabling users to easily adapt and gradually become proficient in utilizing the hybrid mobile application system. The two primary actors within the system are the reporters or journalists, and the editors responsible for editing and organizing the multimedia news content for production or broadcasting by the receiving newsroom or media agency. As depicted in the use case diagram (Figure 4.1), the 'Save Content' use case represents the ability to locally store multimedia content on the device when internet access is unavailable for immediate transmission. The 'Upload Content' requirement can be initiated when the reporter regains internet access, facilitating the seamless transmission of collected content.



**Figure 4.1. Hybrid Mobile e-Reporting Application’s Functional Requirements Use Cases**

The workflow of the mobile e-reporting system transitions seamlessly from one process to another, represented through a UML activity diagram. Both the reporter and editor must undergo authentication to access the hybrid mobile application system. The reporter remotely controls all activities within the hybrid mobile application, as illustrated in Figure 4.2.

However, content uploaded by the reporter only reaches the News Media Outlet when an internet connection is available and the process initiated by the reporter.

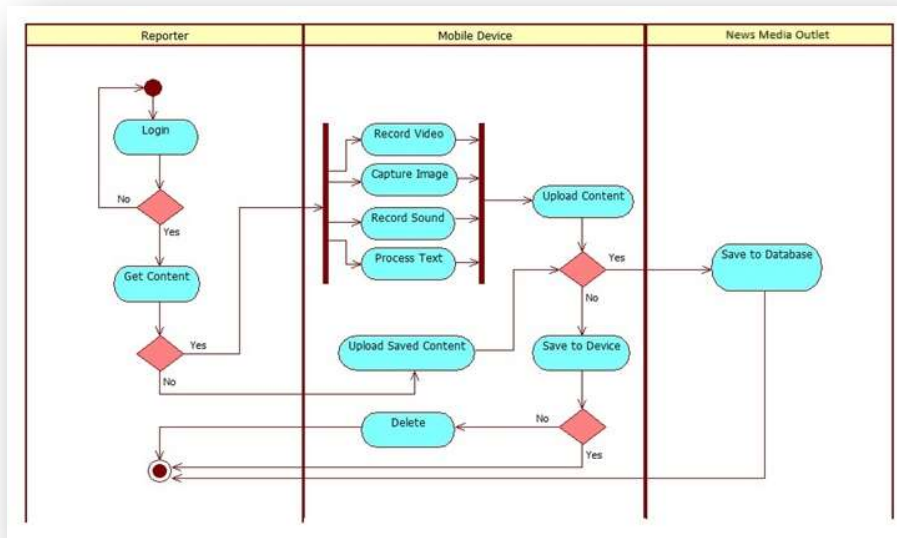


Figure 4.2. Reporter Activity Diagram of the Hybrid Mobile e-Reporting System

The editor can view, play, or download any recorded and uploaded multimedia content from the reporter, as depicted in Figure 4.3.

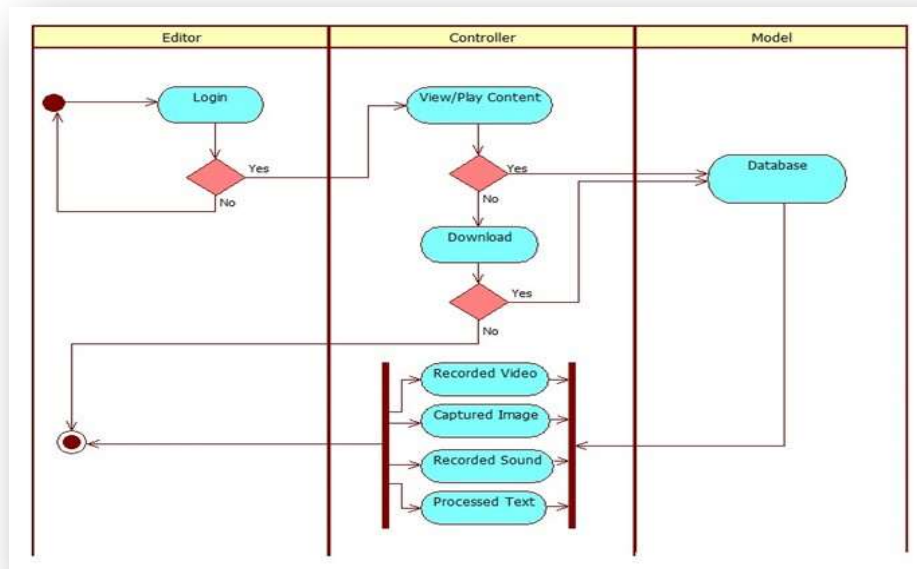
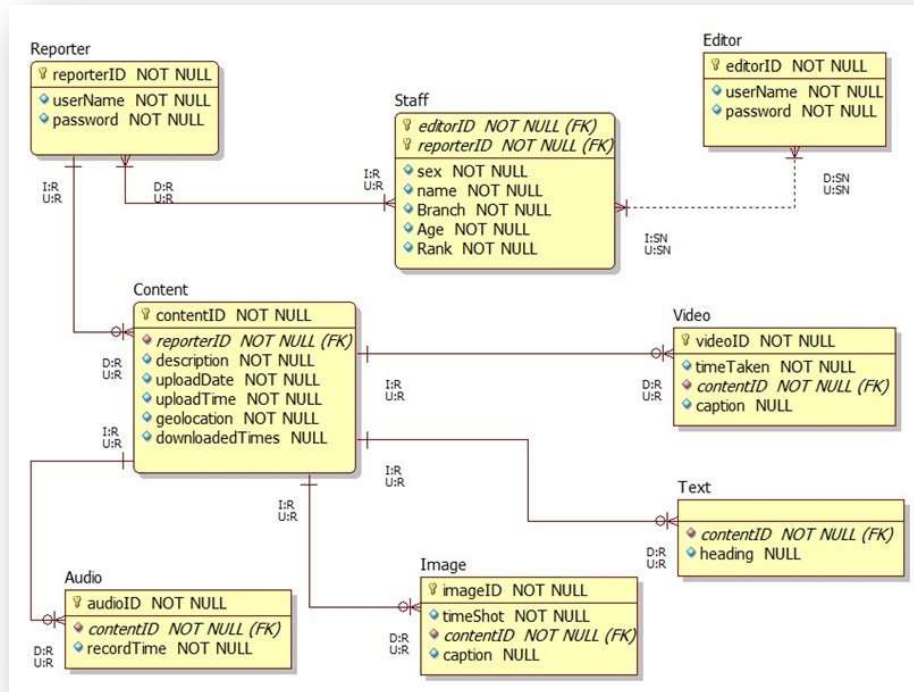


Figure 4.3. Editor Activity Diagram of the Hybrid Mobile e-Reporting System

The entity-relationship diagram (ERD) in Figure 4.4 sheds light on the data requirements and their interactions for the hybrid mobile application system. The ERD encompasses the major activities for the hybrid mobile application, stemming from the reporters' interactions with the system.



**Figure 4.4. Entity-Relationship Diagram (ERD) Presenting the Database Relationship for the Hybrid Mobile Application e-reporting System.**

In Summary, this methodology leverages a hybrid mobile e-reporting system to streamline the news multimedia gathering and distribution process. The system architecture, modelled through UML diagrams, enables secure role-based access where reporters can capture and upload multimedia content through an authenticated mobile application. The application's workflow ensures content is only transmitted to the news outlet when an internet connection is available per the reporter's initiation. The Use Case diagram gives an overall view of the interactions between the use cases of the entire system. The unified modelling language (UML) activity diagrams illustrate the sequential processes and decision points for reporters capturing and uploading content, as well as editors accessing that content for review and dissemination.

The entity-relationship diagram (ERD) provides an overarching view of the system's data requirements and how the core entities like users, content, and credentials interrelate. This mobile e-reporting system architecture allows for a decentralized, rapidly deployable, and secure approach to multimedia news gathering.

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The role-based authentication combined with the local data storage and transmission controls empowers field reporters to work autonomously while still integrating into the centralized news production workflow. The use of proven modelling techniques like UML positions this system design for straightforward implementation and future extensibility. Overall, the system's technical design detailed in this methodology aims to enhance the efficiency, security, and flexibility of modern news production while making optimal use of mobile technologies.

## 5. RESULTS AND DISCUSSION

The hybrid mobile e-reporting application represents a promising solution to address key challenges faced by news reporters in the field, especially those operating in remote areas with limited internet connectivity. By enabling local storage of multimedia content directly on mobile devices, the application overcomes the lack of internet access that hinders traditional reporting workflows. A major strength of this approach is its versatility - the hybrid HTML5 design allows the application to function across a wide range of mobile devices and platforms. This cross-platform capability enhances scalability for potential adoption by news agencies that cannot provide state of the art compatible devices to their reporters. However, the utility of the application is constrained by the specifications and capabilities of the individual mobile devices used. Limited storage capacity could restrict the size of multimedia files that can be captured, especially for video and audio content which are more data-intensive.

Similarly, device performance factors like processing power and memory will influence the efficiency of media capture and transfer. Another strength of this approach is its versatility - the hybrid HTML5 design allows the application to function across a wide range of mobile devices and platforms. This cross-platform capability enhances scalability for potential adoption by news agencies that can provision compatible devices to their reporters. However, the utility of the application is constrained by the specifications and capabilities of the individual mobile devices used. Limited storage capacity could restrict the size of multimedia files that can be captured, especially for video and audio content which are more data-intensive. Similarly, device performance factors like processing power and memory will influence the efficiency of media capture and transfer.

The results indicate that for text and image-based reporting, the hybrid mobile app provides a streamlined and convenient solution even in offline environments. However, for video/audio intensive applications, connectivity and bandwidth requirements become more critical. In such cases, the app should complement rather than replace traditional broadcasting methods, reserving its use for scenarios where real-time streaming is infeasible or for covert reporting that requires discrete capturing. Furthermore, practical considerations like managing intermittent network connectivity, communication breaks between terminals, as well as the mobile nature of field reporting need to be accounted for during implementation. Robust error handling, data synchronization and recovery mechanisms are essential for efficient media transfer when network access is restored.

Overall, the hybrid e-reporting application presents a viable solution tailored to the realities of modern news-gathering. By offering a streamlined workflow integrated with existing mobile devices, it enhances the ability of reporters to overcome connectivity barriers and capture critical stories from even the most remote environments.



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## 6. FUTURE WORK

Future work can focus on optimizing performance across diverse device capabilities, strengthening resilience to connectivity disruptions, and exploring tighter integration with broadcast infrastructure for richer multimedia reporting experiences. Optimizing performance across device diversity is crucial given the varying hardware specifications and capabilities of mobile devices used by reporters in the field. Techniques like adaptive media encoding, efficient compression algorithms, and performance profiling can help ensure smooth operation regardless of device constraints. Additionally, the application could leverage advanced device sensors like high-resolution cameras for enhanced multimedia capture. Strengthening resilience to connectivity disruptions is another key area for improvement. Implementing robust caching mechanisms, intelligent bandwidth optimizations, and seamless data synchronization when transitioning between online/offline modes can enhance the application's ability to handle intermittent or unreliable network access reliably.

Tighter integration with broadcast infrastructure presents opportunities to streamline the reporting workflow further. Enabling remote editing capabilities that allow editors to work directly on multimedia content within the application itself, rather than just downloading files, can accelerate the publishing process. Real-time collaborative editing tools can facilitate seamless coordination between reporters and editorial teams. Moreover, incorporating secure digital rights management and watermarking functionalities can safeguard intellectual property and validate content provenance, crucial in today's landscape of misinformation and deepfakes [36]. Automated metadata tagging and content enrichment utilizing machine learning could provide valuable contextual information to accompany multimedia assets.

The current limitation of editors only being able to download content in its original format restricts their ability to refine and enhance the multimedia package before dissemination. Empowering editors with comprehensive editing capabilities within the e-reporting application itself can unlock higher editorial quality and production value. Ultimately, an integrated end-to-end solution that combines robust multimedia capture, editing, and seamless delivery to broadcast channels can radically improve the speed, quality, and efficiency of news reporting from even the most remote locations in developing countries.

## 7. CONCLUSION

The main goal of this study was to enhance news multimedia content gathering and reporting, particularly in developing countries like Nigeria, by leveraging mobile devices. The objectives were to investigate, identify, evaluate, outline and design the means and aspects necessary to achieve these goals. Through this study, it has been established that the most effective means for developing countries to harness technology in delivering real-time multimedia news is through the use of mobile devices, especially feature phones and older smart Android phones, which are rapidly gaining popularity in Africa [20]. The growing availability of 3G/4G mobile networks in rural areas further reinforces the appropriateness of this approach for news media organizations. While there is a rise in smartphone usage and internet access in Africa, intermittent power supply, terrorist vandalism and the poor IT literacy levels of reporters can hinder the efficient use of mobile technology in reporting.

However, these barriers can be mitigated by implementing strategies such as enabling content to be saved locally on the device until internet coverage is available for uploading, and employing a simple user interface with large icons to indicate available functions, thereby enhancing usability for reporters with limited IT literacy.

A key lesson from this study is that the proposed mobile application design should not be viewed as a replacement for conventional reporting equipment but rather as a supplementary tool for reporters in developing countries. It should be used in conjunction with existing methods, such as emails, file transfer protocols, SMS, free cloud storage, and physical storage devices. Another potential approach could involve leveraging Managed File Transfer (MFT), a proven technology designed with JavaScript/HTML5 for secure and large data transfers [37]. Merging MFT with mobile technology can empower reporters to securely exchange files, collaborate effectively, and access critical data from anywhere, at any time, using their mobile devices. This integration enhances productivity while ensuring data security and compliance. This study has laid the groundwork for further exploration and development of mobile solutions tailored to the unique challenges faced by reporters in developing countries, ultimately contributing to the democratization of information and fostering greater access to diverse narratives.

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## Appendix A

### Storyboard: Hybrid Mobile e-Reporting Application for Developing Countries

This appendix presents the storyboard developed for the proposed mobile e-Reporting application, designed specifically for reporters operating in developing countries. The storyboard was created to facilitate feedback and input from various stakeholders, including reporters, editors, and subject matter experts, during the early stages of the application's conceptualization and design process. The storyboard served as a visual representation of the application's user flow, illustrating the various screens, features, and interactions that users would encounter while utilizing the e-Reporting application. By providing a tangible and interactive mock-up, the storyboard aimed to elicit valuable feedback on the application's usability, functionality, and alignment with the unique needs and challenges faced by reporters in developing countries.

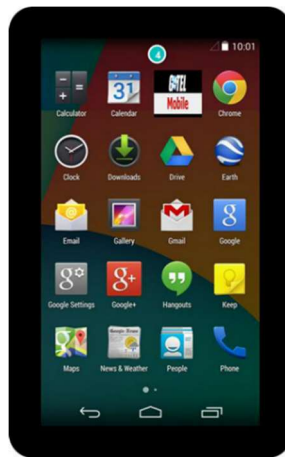
Through this iterative feedback process, the storyboard played a crucial role in refining the application's design and ensuring that it effectively addressed the identified requirements. Stakeholder input gathered from the storyboard evaluation helped guide the development team in making informed decisions regarding the application's user interface, workflow, and feature set. The inclusion of the storyboard in this appendix serves to provide a comprehensive understanding of the application's conceptual foundation and the iterative design process employed in its development. It offers insights into the early stages of the project and serves as a reference for future iterations or adaptations of the e-Reporting application.

1



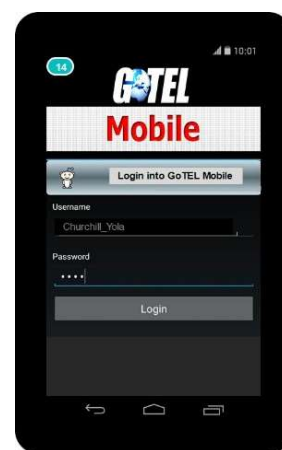
The Normal display for an Android mobile device.

2



The Hybrid Mobile e-Reporting app already installed and displayed as the 3<sup>rd</sup> item top row. It is called 'GoTEL Mobile' named after a Local TV and Radio Station in Nigeria [38]

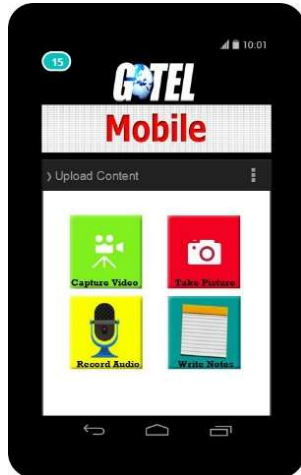
3



Once the app is lunched, a login screen appears asking for the reporter's username and password for authentication.



4



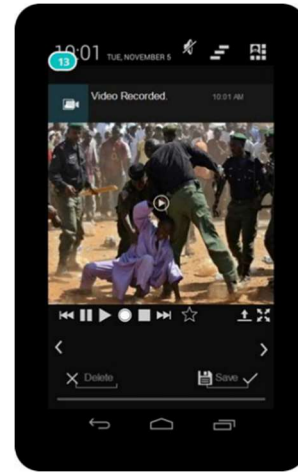
The reporter is given the option to either upload content that was saved offline or choose to capture video, take pictures, record audio or write notes.

5



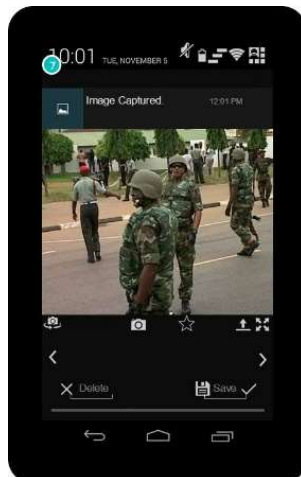
If the reporter chooses any of the four multimedia types, he/she is required to name the content.

6



How the video capturing looks. Record, play and stop buttons, with a delete or save option.

7



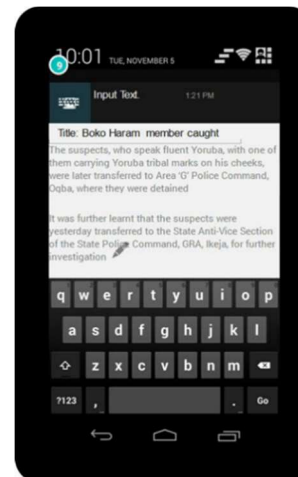
Shows a taken image. It has a delete or save option.

8



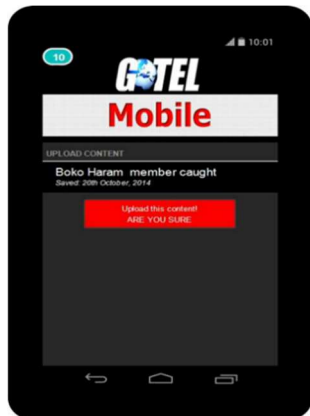
An idea of what the Audio recording screen looks like. It has a delete or save option.

9



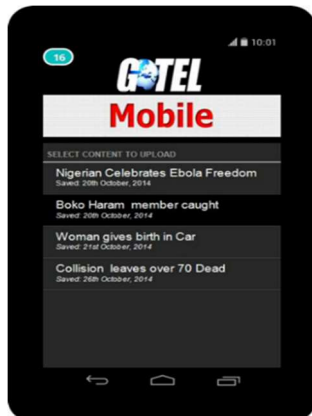
The screen of the word/text process. It uses the mobile's keyboard and has a delete or save option.

10



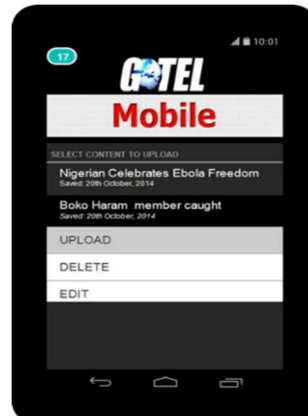
The reporter can choose to upload the whole content that has been obtained. The content is automatically saved if not uploaded at this point.

11



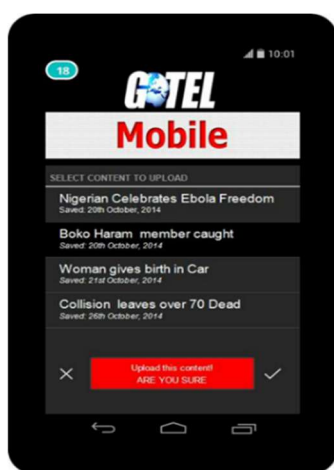
Previously saved content can be uploaded using the upload tab which will display the available contents that have not been upload as a list with the corresponding date it was created and saved.

12



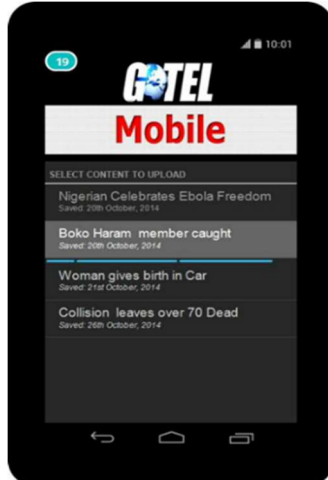
The selection screen to upload, delete or edit the content from the drop-down menu.

13



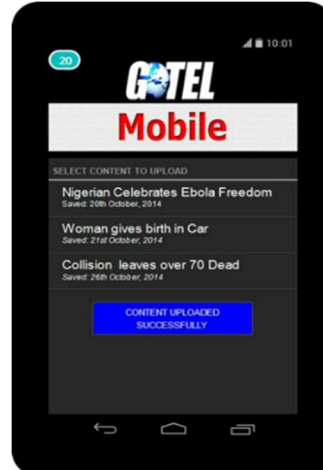
Prompted with a second chance button to upload content.

14



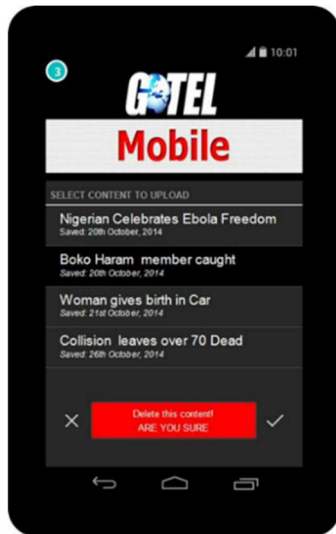
The blue indicator shows the content being uploaded. It also indicates poor connectivity based on the time it takes to complete the upload.

15



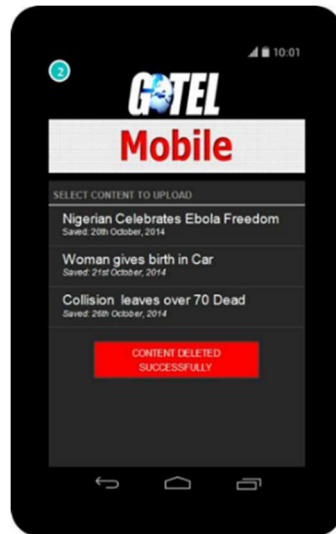
The uploading bar (indicator) turns blues after the upload is successful and removes the content from the list.

16



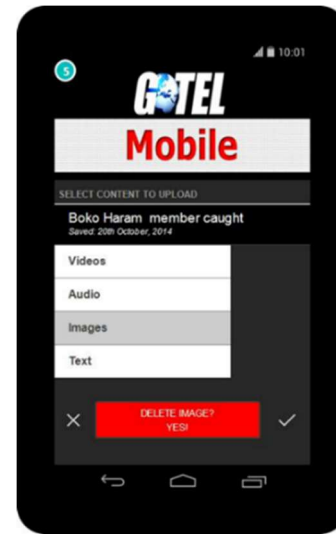
A warning message appear, giving the reporter a chance to confirm or revert their choice to delete content.

17



A successfully deleted message showing once the action to delete had been confirmed.

18



The 'edit menu button' from screen 12 gives the reporter the option to delete a specific type of multimedia content that is attached with the main news content that was saved for a specific event.