Sher-Locked: A Hybrid Deep Learning Model Based Mobile Platform for Social Media Fact-Checking

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ABSTRACT In the present context, false news can be easily constructed and circulated through various social media platforms. As a result, people on those platforms have difficulty in distinguishing between correct and incorrect information. Therefore, a firm desire appears to develop a fact-checking platform to address this issue. From this research study, the authors present 'Sher-Locked' which is a hybrid deep learning model based mobile platform to fact-check information on social media. The process of checking and verifying information is referred to as fact-checking. A hybrid deep learning model which is mainly focused on CNN and RNN-LSTM networks integrated with the mobile application to check and verify information on social media. The high-level characteristics and interdependencies among the input text capture from the hybrid model. The mobile application consists of several features such as fact-checking, daily news updates, news reporting, social media trends and daily COVID-19 reports. Flutter chose as the mobile application development framework along with Firebase as the backend development framework with REST APIs to develop the entire system. When checking and verifying the information mitigating on social media, the hybrid model achieved a 92% accuracy by surpassing most of the traditional models today with 91% score rates for Precision, Recall and F1-Score. After delivering the mobile app as a complete system to various users for testing, the authors discovered that the user satisfaction and usability rates are high when compared to other related software.

KEYWORDS: Deep Learning, Fact-Checking, Fake News Detection, Hybrid Approach

I INTRODUCTION

Nowadays, social media is used by almost half of the population worldwide. As a result, people are shifting away from conventional news media and moving towards new social media platforms. Furthermore, by surfing through social media news feeds people can get to know about what is going on around the globe. Because of the openness and clarity afforded by such social media platforms, at any moment anybody can assert anything that results in the development and dissemination of misleading information via social media platforms. As a result, people on those platforms have a challenging time distinguishing between correct and incorrect information.

Most Sri Lankans are unable to recognize misleading content in their social media posts because of the limited number of verified accounts to check the content. As a result, most of them share the posts and articles except confirming them and this points to propagating false information via social media platforms. As an example, During the 2019 Easter Sunday attacks in Sri Lanka, the authorit-

ies chose to restrict the social media access because of misinformation and hoax propagating rapidly on social media that drives misunderstandings between people and religions [2]. Not only that, but before the 2019 Sri Lankan presidential election, a lot of misleading information was generated and distributed via social media platforms to influence people's perceptions and attitudes [3]. Following figure 1 represents the social media ban related news headline in Sri Lanka in 2019.

There have been numerous scenarios recorded from various countries that related to the propagation of misinformation. During the 2016 US presidential election, "Pizzagate" false news was rapidly propagated on Twitter, resulting in over one million tweets [4], and for insulting a Quran statement during the 2016 Jakarta gubernatorial campaign, governor Ahok was convicted to two years in jail [5]. Following figure 2 represents the above incident.

Figure 1 : Social media ban in Sri Lanka in 2019
Source: https://images.app.goo.gl/ydmFT2pdZLrxghgm8

Figure 2 : Gubernatorial campaign in Jakarta in 2016
Source :
https://images.app.goo.gl/H3wG2iEg8YmurCB37

As per the above, these incidents have evidently demonstrated that a firm desire appears to develop a fact-checking platform to address these issues. Following figure 3 represents the problem statement related to a false message received via WhatsApp.

From this research study, the authors present 'Sher-Locked' which is a hybrid deep learning model based mobile platform to fact-check information on social media including other functionalities such as fact-checking, social media news trends, news reporting, daily news updates and daily COVID-19 reports etc. This is the final version of the mobile application called 'SherLock' [6] developed by the authors.

The primary goal of this research work is to reduce the effort and time to verify the legitimacy and trustworthiness of social media posts utilizing contemporary technology primarily for social media users and traditional media consumers.

The remainder of the paper is formed in this way. Section II depicts the related works and tools with a comprehensive review and Section III enhances the design and implement-

Figure 3 : False message received via WhatsApp

ation of the system. After that, Section IV demonstrates the technologies that are adopted to develop the system. Furthermore, Section V describes how the mobile app works and Section VI comprises of evaluation and testing of the system. Finally, Section VII represents the conclusion and future work of the research study.

II   LITERATURE REVIEW

A substantial number of researchers have investigated this area and developed some tools to overcome this problem. Hoaxy [7] is a website that collects and tracks misinformation. The misinformation that is captured from Hoaxy can be visualized using technologies such as web scraping, Twitter API, web syndication and RSS parser. By the use of deep learning methods such as LSTM and autoencoder FakeNewsTracker [8] gathers and visualizes false news on social media.

A tool called 'dEFEND' has been developed using the Hoaxy API to form a news dissemination network that includes the latest popular news and top assertions. That tool can provide further explanation for Twitter user remarks as well. News Verify [9] was created to identify the trustworthiness of news by utilizing techniques such as sentiment analysis, feature extraction and web crawling etc.

The authors of [10] created a 'B.S. Detector' plugin for both Mozilla and Chrome browsers that checks untrustworthy sources against a personally curated list of domains. A deep learning network that consists of several methods such as word2vec, CNN, feature extraction and word embeddings is applied in Fake News pattern Detector [11] to identify patterns in false news. An LSTM-RNN model is used in TRACEMINER [12] to afford good accuracy.

Software	Filter Fake News Articles	Send Alerts about Fake News and Breaking News	Check credibility and validity of social media posts	Add a crowdsource fact-checker	Leverage app usage statistics for users
Oigetit	✓	✗	✗	✗	✗
WatchDog	✗	✓	✗	✗	✗
Fact-Bounty	✗	✗	✗	✓	✓
Listle	✗	✓	✗	✗	✗
SherLock	✓	✓	✓	✓	✓

Figure 4 : Comparison of features in related software

Following are some of the existing research works that are carried out in this false news detection area.

Based on machine learning methods and n-gram analysis in [13] authors presented a false news detection algorithm. Six alternative machine learning algorithms were explored and compared by the authors, namely, Linear Support Vector Machines (LSTM), Stochastic Gradient Descent (SGD), Support Vector Machines (SVM), Decision Trees (DT), K-Nearest Neighbour (KNN) and two various feature extraction methods, namely, Term Frequency-Inverted Document Frequency (TF-IDF) and Term Frequency (TF). To describe the context of the document and create characteristics to categorize it, a word-based n-gram is utilized. In the data pre-processing steps authors performed some modifications such as tokenization, stop-word removal, punctuation removal, sentence segmentation and a lower casing to minimize the size of real data and eliminate the useless information. The authors looked for the false news dataset on Kaggle.com [14] and for real news items, real news sources as Reuters.com [15] explored. Furthermore, using the dataset Horne and Adali [16] the authors evaluated their model. The authors also examined the dataset known as the LIAR dataset [17]. Authors [18] conducted a review on media-rich false news identification and claimed that the majority of false news identification techniques are formed on feature extraction methods.

In [19], [20], [21], [22], [23] and [24] authors presented techniques which are formed on feature extraction methods. Linguistic features-based techniques, such as punctuation, n-grams, readability, psycho-linguistic aspects and syntax utilized to extract significant linguistic aspects from false news. Authors employed n-grams such as bigrams and unigrams to extract information from a group of words in a tale, and punctuation aids in distinguishing between genuine and false texts. LIWC lexicon approach was utilized to choose optimal proportions. Furthermore, readability measures such as Flesch Reading Ease, Gunning Fog, Flesch-Kincaid and the Automatic Readability Index (ARI) were utilized to extract the content elements such as word count, complicated words and word kinds [25].

The syntax approach extracts Context-Free Grammar (CFG) based characteristics. Vector Space Modelling (VSM) and Rhetorical Structure Theory (RST) are utilized to model deceptions. RST is utilized to identify the logic of a tale in terms of functional matchings [26] and VSM is utilized to find rhetorical structure matchings of a text [27], [28]. RST-VSM approach outperformed similarity cluster analysis significantly. A vast amount of data was compared using Clustering-based approaches. Authors created GCLUTO (Graphical Clustering Toolkit) to distinguish news items based on their comparison using the Euclidean distances values and K-Nearest Neighbour approach. Predictive modelling-based strategies employed logistic regression model whereras content cues-based methods analyzed syntactic and pragmatic levels of analysis and lexical and semantic levels of analysis. Authors presented non-context-based approaches for manipulating emotions and understanding user behavior on social media, such as picture analysis and user-behavior analysis. Based on the study, authors presented various prominent datasets that utilize for false news identification such as [29], [30] and CREDBANK [31] etc. In their survey, the authors recommended various open research issues such as multi-model verification approach, multi-model dataset, author trustworthiness check and source verification. Authors [32] utilized linguistic analysis on tweets to generate a bag of words for pattern identification before applying K-Nearest Neighbour algorithms to assess reputable news sources.

The authors of the paper [33] outlined various approaches for combating false news. Recursive Trust Labelling (RTL) is a flexible learning algorithm that utilizes linguistic characteristics as well as a graph-based classifier with recursive labelling techniques. The authors achieved a high accuracy by employing Hidden Markov Models (HMMs) and characteristics such as n-grams and body text lexical measurements. The authors extracted statistics from Twitter's historical API and utilized Rumour Gauge to forecast the authenticity of rumours on Twitter.

The authors of the study [34] explored several deep learning mechanisms to identify false news. Authors investigated deep learning mechanisms such as Very Deep Convolutional Neural Network (VDCNN), Shallow Convolutional Neural Networks (CNN), Gated Recurrent Unit Network (GRU), Long Short-Term Memory Network (LSTM), Convolutional Neural Network with Gated Recurrent Unit (CNN-GRU) and Combination of Convo-

lutional Neural Network with Long Short-Term Memory (CNN-LSTM). When the authors utilized Convolutional Neural Networks (CNN) they achieved better accuracy. In addition, the authors investigated the efficacy of word2vec and word embeddings functions in Deep Neural Networks. Following are some of the available strategies for dealing with false news the majority of the time.

- Verified News Sources:- One of the methods to distinguish between false and authentic news items is to use verified news sources. This strategy makes it simple to distinguish between false and legitimate news reports on social media networks. ([35], [36])

- Fact-Checking Websites:- Focusing on the most recent news worldwide these websites provide rapid updates on the situations that are occurring throughout the world. These websites assist in distinguishing between true and fraudulent news on social media networks. ([37], [38])

- User Profile Based Approaches:- User-based techniques refer to how social context aids in distinguishing between false and true news items. Explicit profile elements such as status count, verified user accounts and follower count aid in determining whether or not a user account is false. [39]

- Google Reverse Image Search:- This reverse image search is used to submit a picture and manually examine incidents linked to that image, which aids in distinguishing between false and real photographs on social media sites. [40]

As described in the literature review a large number of researchers presented numerous techniques to form the research study. However, following the existing mechanisms, techniques and related works a CNN, RNN-LSTM based hybrid model was selected as the method to develop the main feature which is the fact-checking feature of the proposed mobile app. Because, as evidenced by similar studies, integrating many Deep Neural Networks yielded some highly accurate findings.

From the third chapter of the paper, the authors demonstrate the design and implementation of the suggested mobile app. The design and implementation chapter elaborates the high-level software architecture of the suggested system, the software process model of the suggested system and the walkthrough of the interfaces of the suggested system.

III   DESIGN AND IMPLEMENTATION

A   The High-Level Architecture of the System

A. The High-Level Software Architecture of the System The suggested system comprises various components including MVVM architecture which highlights the mobile application development pattern which is the model-view-view-model pattern. The mobile app is built on consists of various functionalities such as fact-checking, social media news trends, news reporting, daily news updates and daily COVID-19 reports. After that, the cloud database is developed by including a few crud operations for all the functionalities of the mobile app. To create the hybrid deep learning model REST APIs and web scraping methods are utilized to gather facts from various news items. Following that, the hybrid deep learning model is also kept in the exact cloud database.

Figure 5 depicts the high-level software architecture of the suggested system. As for the suggested system's front end built a mobile app with the aforementioned functionalities. Furthermore, the suggested system's backend employed a cloud-hosted database to keep the hybrid deep learning model.

B   Software Process Model of the System

Dividing requirements into modules and smaller systems is the Incremental software process model [41]. As a result, the suggested system used an Incremental software process model.

Figure 6 depicts the software process model of the system. The first subsystem collects information to develop the deep learning model, and the second subsystem uses the hybrid deep learning model to check social media postings. The last subsystem makes use of the mobile app to check the status of the postings.

C   Walkthrough of the Mobile App interfaces

The suggested mobile app comprises many interfaces such as registration screen, onboarding screen, home screen, login screen and other function-specific screens. However, just the screens of the main functionalities are included here.

Figure 7 demonstrates the latest global news interface. Based on the interests users can shift between various news categories. This function displays the most recent worldwide news classifying it as health, sports, entertainment, science and business. The user can get to know further information about particular news by clicking on the news article.
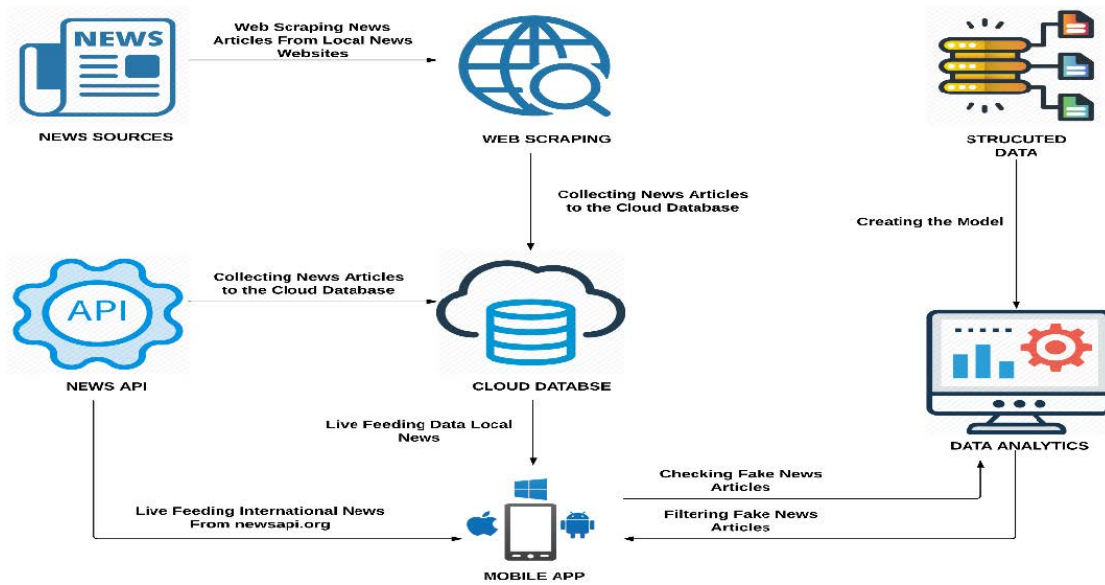
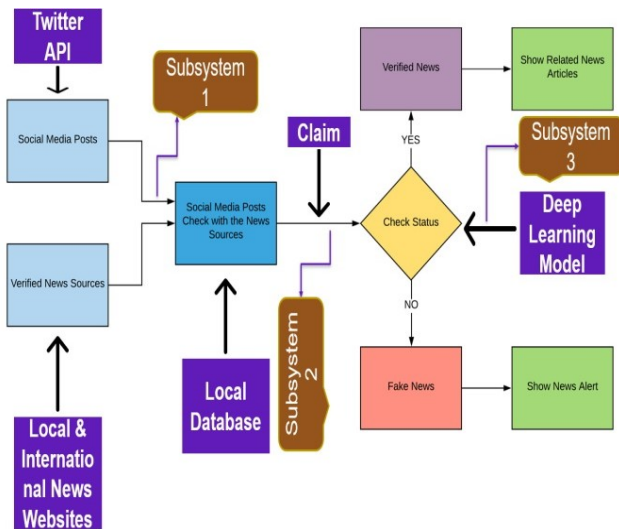Figure 5 : The high-level architecture of the proposed system

Figure 6 : The software process model of the proposed system

Figure 7 : The latest global news screen

Figure 8 depicts the newest fact-checking and Twitter trends. If the user wishes to learn further about certain news trends, they can follow the news story which takes them to a page with additional information about the trending news stories.

Figure 9 depicts the news reporting interface from which news reporters can submit news to the platform by giving accurate information such as the relevant photography of the news, the reporter's identity, the caption of the news and more details about the news.

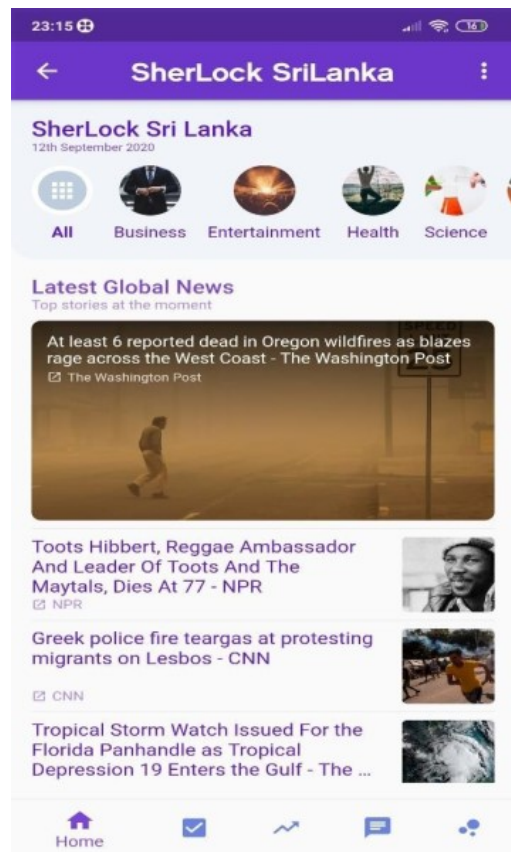Figure 10 demonstrates the latest COVID-19 updates in Sri Lanka and in Globe. Based on their preferred languages users can get to know more facts. The majority of the data consists of total fatalities, total local and global cases, total
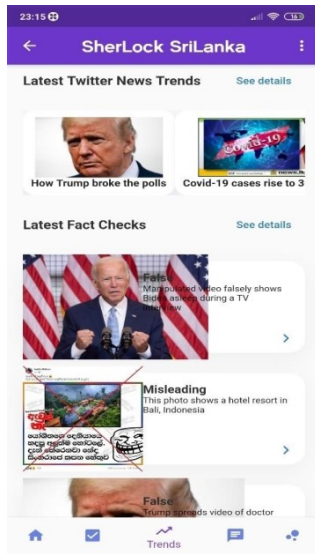
Figure 8 : Latest Twitter trending news screen

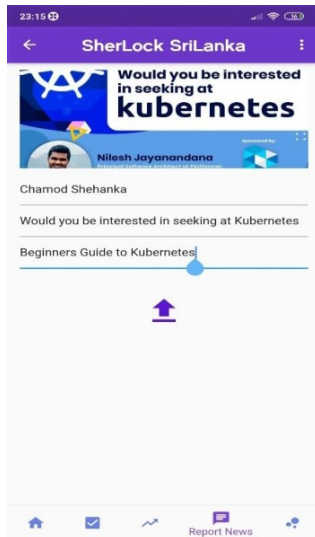Figure 10 : COVID-19 updates using English language

Figure 9: News reporting screen

Figure 11 : COVID-19 updates using Sinhala language

recovered and hospital statistics.

Figure 11 demonstrates the daily COVID-19 updates interface in the Sinhala language.

Figure 12 depicts the mobile application's key capability, which is the fact-checking of social network posts. Based on the text input by the user, the hybrid model determines whether the social media postings are authentic or fraudulent.

For example, if the user enters the message as in figure 16 the hybrid model checks and displays a message as confirmed news by highlighting the content in green. If the user enters a text as in figure 18 then the hybrid model flags it as a forgery by displaying the text in red. The CNN, RNN-

LSTM-based hybrid model is utilized in this interface to fact-check social media postings.

IV TECHNOLOGY ADOPTED

A Flutter

The purpose for utilizing Flutter [42] as the suggested mobile application's front-end framework is to create attractive, natively build mobile applications using a single code-base for both Android and IOS versions. The nicest thing about Flutter is that it is accessible easily with native APIs. In contrast to the existing frameworks, Flutter offers a rapid development approach by providing some basic interfaces.

Figure 12 : Fact-checking screen

B Firebase

The proposed application deals with a wide range of unstructured data types. As a result, Firebase [43] is used as the suggested system's back-end framework. Login screen utilized to authenticate users from Firebase Authentication. And to collect news reports Firebase Database is utilized. Then Firebase Storage is utilized to store illustrations of the news reports. Finally, to keep the hybrid deep learning model Firebase Machine Learning is adopted.

C Scrapy

Using the web scraping approach data are gathered from several news items prior to developing the hybrid deep learning model. For that, Scrapy [44] which is a free web scraper and web crawler is used.

D TensorFlow

TensorFlow [45] is utilized to develop the hybrid deep learning model while Python is chosen as the programming language. As it offers significant help for both front-end and back-end frameworks and as well as a diverse and vast ecosystem.

E GitHub

GitHub [46] is utilized to manage the project repository for the suggested system. GitHub Actions [47] is utilized to construct the CI/CD (Continuous Integration/Continuous Delivery) pipeline and publish the mobile app.

F IntelliJ IDEA

IntelliJ IDEA [48] is chosen as the IDE for developing the mobile app as it offers significant help for both front-end and back-end frameworks and as well.

G PyCharm

PyCharm [49] is chosen as the IDE for developing the data gathering process. Furthermore, Natural Language Processing methods such as Tokenization, Preprocessing and Word Embeddings are included. After completing the above steps build the hybrid model.

H Kaggle Kernels/Google Colab

Because of the amount of the dataset and the model's complexity, the hybrid deep learning model required additional processing resources to run. Following that, to execute the model Kaggle kernels

V HOW MOBILE APP WORKS

The suggested mobile app developed including various main functionalities such as fact-checking, social media news trends, news reporting, daily news updates and daily COVID-19 reports.

To begin, the user must register with the system by giving accurate information. All the functionalities of the mobile app can be accessed by the admin user. Other users can only access defined functionalities. From the target stakeholders, the news agency can access all the functionalities of the mobile app and other users like social media users, daily newsreaders and daily news reporters can access specific defined functionalities only. For example, daily news reporters can access the news reporting functionality, but the other secondary users cannot access that functionality. Role-based authorization is utilized to control the access for different user roles.

From the following subtopics, we demonstrated how the main functionalities such as fact-checking, social media news trends, news reporting, daily news updates and daily COVID-19 reports of the suggested mobile app works.

A Latest Global News Feature

The user gets to the homepage after providing the right details. Based on their interests users can shift between various news categories. This function displays the most recent worldwide news classifying it as health, sports, entertainment, science and business. The user can get to know further information about particular news by clicking on the news article. This function is accessible to all users. News API [52] is utilized to retrieve the latest news items to the mobile app through an endpoint.
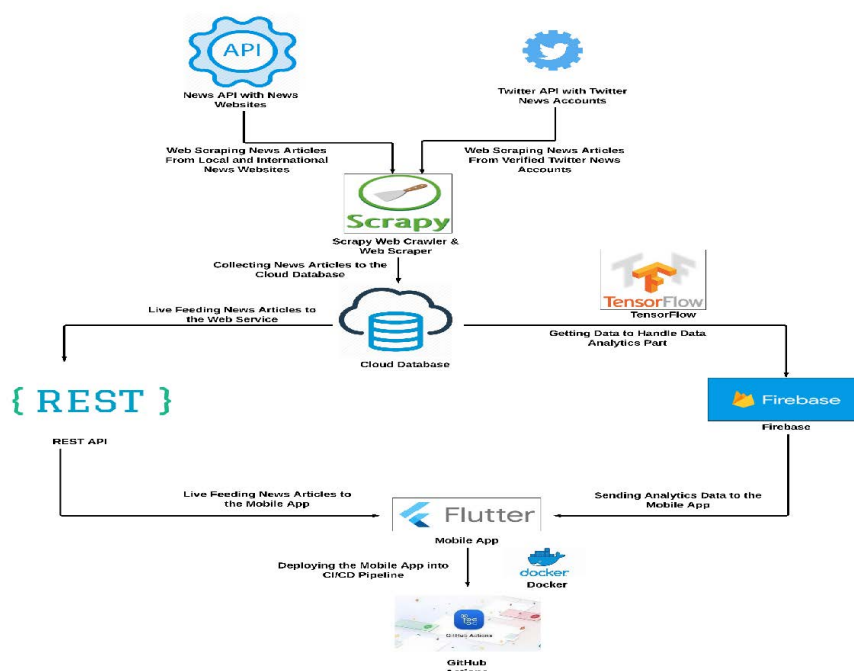
Figure 13 : The overall technology map of the system

B Fact-Checking Function

Using the bottom navigation bar the users can get to the fact-checking function where they can utilize the CNN, RNN-LSTM based hybrid model to fact check social media postings. The hybrid model determines whether it is legitimate or bogus news based on the user's inputs. For example, if the user enters the message as in figure 16 the hybrid model checks and displays a message as confirmed news by highlighting the content in green. If the user enters a text as in figure 18 then the hybrid model flags it as a forgery by displaying the text in red. By comprising various deep learning methods, the hybrid model achieves 92% accuracy. The high-level characteristics and interdependencies among the input text capture from the hybrid model. The following paper by the authors [53] provides further information regarding the CNN, RNN-LSTM hybrid model. This function is only available for social media users to reduce the effort and time to verify the legitimacy and trustworthiness of social media posts. TensorFlow is utilized to create the hybrid deep learning model followed by Firebase Machine Learning to keep the model and REST APIs [54] connect with the model when using the Flutter framework.

C Latest Fact-Checkings and Latest Twitter News Trends Function

All the users can access this function. The newest fact-checking and Twitter trends can be visible using this function. If the user wishes to learn further about certain news trends, they can follow the news story which takes them to a page with additional information about the trending news stories. To obtain the most recent Twitter trends Twitter API [55] is utilized and websites such as AFP-Fact Check is utilized to obtain the most recent fact checkings.

D News Reporting Function

Only the news reporters allow access to the news reporting function using the bottom navigation bar. News reporters can submit news to the platform by giving accurate information such as the relevant photography of the news, the reporter's identity, the caption of the news and more details about the news. Only news reporters can access this function. To collect news reports Firebase Database is utilized. Then Firebase Storage is utilized to store illustrations of the news reports.

E Daily COVID-19 Reports Function

The final function of the bottom navigation bar is daily COVID-19 reports. The latest COVID-19 updates in Sri Lanka and in Globe represents from this functionality. Based on their preferred languages users can get to know more facts. The majority of the data consists of total fatalities, total local and global cases, total recovered and hospital statistics. For all the local languages Localization is included. To retrieve the latest facts using the cloud-hosted database REST APIs are utilized. Furthermore, Localization for all the local languages is included using Google Translate.

VI EVALUATION AND TESTING

The entire project is carried out using the test-driven development process. To assure the functioning of the mobile app various automated tests are performed. To test the functionalities of the mobile app unit tests are utilized and UI is tested by performing widget tests.

Postman [56] is utilized to ensure that all endpoints function properly in various circumstances. Following that, to test the entire mobile app end-to-end tests and integration tests are investigated. When submitting pull requests to the main branch GitHub Actions CI/CD pipeline is selected to perform automated test scripts.

A suitable test strategy is required to test a system in a systematic manner. The test plan outlines how to carry out Integration Testing and Unit Testing effectively.

A Unit Testing

Unit Testing is conducted to ensure that all the system's modules are working properly before the system integration. Unit Testing covers the main modules of the system.

Following Table 1 points out Unit Testing that is carried out for different modules of the system.

Table 1. Unit testing for different modules

Module	Description
Authentication Module	The authentication module is tested by using different combinations of user names and passwords to make sure that all fields are validated properly. For user login details data are cross-checked with the database.
Administration Related Tasks	Administration related tasks are tested properly to make sure that there are no errors in the admin panel.
Latest Global News Module	Endpoint level testing is done to test this functionality to check that all the data which are calling from the endpoint are matched with the data which we can see from the front-end mobile app.
Fact-Checking Module	Fact-Checking module is tested properly with several datasets to make sure that the function is working properly. It also evaluates deeply with running several test scenarios on it as well.
Latest Twitter News Module	Both endpoints and websites are cross-checked to validate the data which we are getting to the front-end mobile app.
News Report Module	The news report module is tested to make sure that it triggers the correct crud operations to store the news reporters in the storage and store the operational data in the database.
COVID-19 Report Module	Endpoint level testing is done to test this functionality to check that all the data which are calling from the endpoint are matched with the data which we can see from the front-end mobile app. Localization is also tested properly as well.

B System Testing

System Testing is conducted to ensure that all the system's features are working properly. System Testing covers the main features of the system.

Following Table 2 points out System Testing that is carried out for all the features of the system.

Table 2. System testing for all the functionalities

Test Scenario	Description
Login Function	Test user login function for valid user name and password. User login can identify the user credentials correctly. Only the registered users can log in to the system.
Admin Related Function	Admin can add/edit/delete users and can assign the correct user to correct functionality. Test whether the admin can add/edit/delete users and can assign the correct user to the correct functionality.
Fact-Checking Function	The fact-checking function can check the new social media posts and stories. The test case can be run to check whether the function is working properly to check the fact-checking function.
Latest Twitter News Function	The Latest Twitter news function can show the latest Twitter trends and news stories with insights from trusted news agencies. The test case can be run to check whether the function is working properly to check the function.
News Report Function	The news report function can use to report the latest news updates to the portal. The test cases can be run to check whether the function is working properly for news reporters to report the news to the portal.

A recent message presented in figure 14 is utilized to test with the proposed hybrid model, the given message is la-

"Amitabh Bachchan & Abhishek Bachchan test positive for COVID-19."

Figure 14 : Experiment - message 01

belled as real news by envisioning a score of 0.9950. For the second message, as illustrated in figure 15, also evalu-

"All the universities and schools remain closed for two months due to the coronavirus outbreak in the country".

Figure 15 : Experiment - message 02

ated using the proposed hybrid model and it is forecasted as false news with a score of 0.4190. Recent news which is in figure 16 is chosen as the third message, and it is forecasted

"Dalada Maligawa website comes under cyber-attack."

Figure 16 : Experiment - message 03

as real news by giving a score of 0.8509 from the proposed hybrid model. After that, a lengthy statement consisted in a social media post in figure 17, chose to evaluate using

"A video has been shared thousands of times in multiple posts on Facebook alongside a claim that it shows a rally against coronavirus restrictions in the British capital of London."

Figure 17 : Experiment - message 04

the proposed hybrid model. And it is predicted as false news with a score of 0.0015. With that, a lengthy statement which is received via WhatsApp selected to evaluate using the proposed hybrid model in figure 18, by project-

"A photo has been shared in multiple Facebook posts alongside claims that it shows deforestation in Sinharaja, a protected forest reserve in Sri Lanka."

Figure 18 : Experiment - message 05

ing a score of 0.0050 it is once again labelled as false news. Finally, a recent message in figure 19 is tested with the proposed hybrid model, with a score of 0.9847, it is correctly

"'Black Panther' star Chadwick Boseman dies of cancer at 43."

Figure 19 : Experiment - message 06

predicted as real news.
After testing various messages using the proposed hybrid model, Table 3 points out the experiment results which are examined from the proposed hybrid model.

Table 3. Experiment Results

Input Text	Predicted Results	Label	Actual Result
Message 1	0.9950	Real	Real
Message 2	0.4190	Fake	Fake
Message 3	0.8509	Real	Real
Message 4	0.0015	Fake	Fake
Message 5	0.0050	Fake	Fake
Message 6	0.9847	Real	Real

Docker [57] is utilized to improve the performance of the mobile app during the evaluation phase. The mobile app is then compressed using app bundle packages to minimize its size. When utilizing Flutter as the front-end framework, the suggested mobile app is adaptable for both Android and IOS versions. After giving the mobile app to use as a complete system to some users for testing the authors found that

the user satisfaction and usability rates are high when compared with other related software in figure 4.

VII CONCLUSION AND FUTURE WORK

Finally, the research proved that the suggested mobile app is a viable option for Sri Lanka as it contains various functionalities such as fact-checking, social media news trends, news reporting, daily news updates and daily COVID-19 reports. Furthermore, the key functionality of fact-checking is becoming increasingly important for everyday social media users to discern between legitimate and false news items and social media postings.

In terms of future work, the suggested mobile app is expected to be released to the public as a full system with Android and IOS versions. As a result, the authors expect to publish the mobile app freely available on both Android and Apple stores.

VIII PROJECT REPOSITORY

Project Repository URL:
https://github.com/pathumveyron24/PG-FYP-SherLock

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CONFLICT OF INTEREST

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