Data Analysis of Real-Time Bus Tracking and Administration System Using Machine Learning

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Abstract: The massively populated states in the country need an efficient and the effective transportation system for public use. In countries with great population like India, public or government transport is the mode of transport used by majority of masses. The android application developed for this system with the use of machine learning technology simplifies the transportation for travellers and management people as well. Tracking the real time location and updating the data in the timely manner on the application advances the efficiency of government as well as public transport system.

Keywords: Data Science, Machine learning and algorithms, Bus transportation and administration, Analytics

I. INTRODUCTION

Government does not have any real-time statistics or data about particular bus location, condition or happenings. Passengers keep waiting without any acknowledgment and it is time consuming. The depot does not have confirmation if there is any incident or natural disaster or acknowledgment about people's safety. Bus administration is affected by any kind of such accident, natural disasters, and strikes. The real time bus location tracking is helpful for government administration as well as for public. The application will update dynamically data about the bus condition and real time statistics. Enhancement in technology provides the opportunity for eliminating the drawbacks of existing system.

II. RELATED WORK

Various designs have been proposed and implemented in case of real-time vehicle location tracking system. All the design and implementation techniques are unique and different from each other. Our "Track-O-Bus" android application system consists of location tracking without using any external physical IOT devices like sensors, arduino which consist data about arrival and departure time of buses, infrastructure and availability of resources at the public transportation system like MSRTC, etc. Many research papers, journals, books comment and describe about real-time location tracking system with their own design and implementation methodologies. Prof. Richard Joseph has proposed a location tracking system using Google map API and GPS[1]. Meghana Survase and Pratibha Mastud has mentioned the centralized bus system architecture which consists of Bus module,Central control unit ,Client side application as operating part for location tracking system with the help of GPS device[2]. Unmesh Kanchan and Prof. Seema Vanjire has proposed a new system LBS which is location-based services which provides location tracking with GPS and Google map API [3]. Nirmal Haldikar and Mihir Garude has implemented a location tracking system using Google map API with sensor and GSM technique [4]. The approximate estimation of time and distance required for bus to reach destination is mathematically calculated by P.Madhu Bala and S.Sivaraman with artificial nueral network agenda [5]. GPS-based Location Tracking System via Android Device developed by Md. Palash Uddin and Md. Nadim uses database query language for tracking location [6].The transport tracker system provided by Google helps to find and track real-time location using map API in android, IOS mobile phones and web applications [7].The asset tracking steps and implementation provide tracking of assets like bus, driving truck, vehicle [8].The firebase implemented by Google helps to store, retrieve and manipulate with data for various purposes [9]. Rupali Mahind and Amit Patil have given a study overview on what is AI? How machine learning and data science is helping the world with latest innovations and opportunities [10]. Author Amit Patil has implemented the real-time bus location tracking and administration system and provided deep analysis on how system is implemented and works for real time scenarios [11].

III. EXISTING SYSTEM

Nowadays, applications or systems available for bus transport are mostly for private transport and not specifically for government transport. Unreliable bus transportation is actually national problem, especially in areas where there is no option for public transport like local railways, government bus transport and such areas are major focus under consideration.
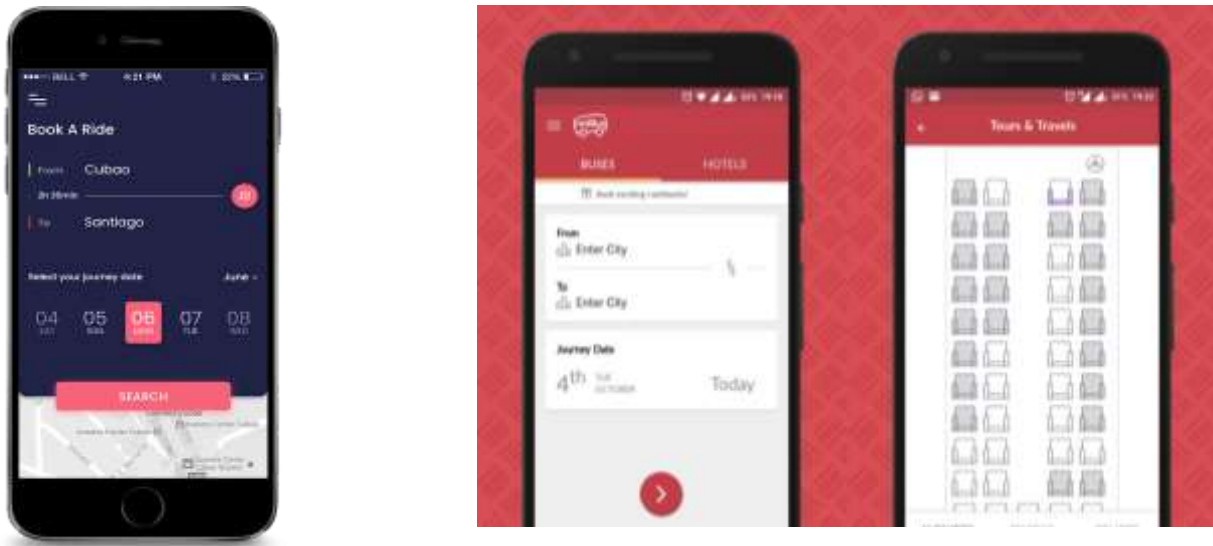
Fig 1. Various existing applications like Redbus, Track My Bus

Karad is a city in state of Maharashtra, India. The National Highway (NH4) goes by Karad city that links four of the ten most populous Indian cities - Mumbai, Bengaluru, Chennai and Pune. This city has lack in management for major scale public bus transportation. System use by depot is inefficient and inconvenient to travelers.

Applications like APSRTC ,Red bus, Track my bus, where's the bus, etc. asks the end users to choose and pick their bus from multiple options by an operator that fits your schedule and payments 0r choose a bus based on fellow customer feedback and ratings for each operator.

The application has to be operated by multiple operators and hence operators should be registered at application administrative system. Due to limited and unreliable business scenarios, even operators do not take risk in investing such applications.

The existing applications provide various functionalities like route mapping, seat reservation, timing alerts. Entertainment resources, bus distance and timing schedules which can be not so much important aspects than real-time location tracking using Google map API provided my our proposed system.

Unless the operator gets contracted with existing applications, so remote users cannot get access to these facilities at undeveloped routes and geographical areas. For public transportation systems, cost, time and human resource management is very important portfolio.

The public transportation systems should be provided with cost effective and easily accessible android application which can describe bus time, distance and bus schedules, real-time tracking as well as complete data analysis for all kinds of money, time, human resources, scheduling of buses in firebase database console.

IV. PROPOSED SYSTEM AND IMPLEMENTATION

'TRACK-O-BUS'::

With increased mass population and fast growing techno-savvy world, there is need of cost-effective and time reducing bus transport tracking and management system. The increasing population and tiring paper-pen procedures, inadequate bus transport corporation's facilities and inappropriate human resources and cost management has been leading to very poor real-time data analysis of transport facilities. Therefore bus transport facilities like MSRTC and remote user needs a smart system which provides real time location and information of bus. So we proposed a new system "Track-O-Bus" android mobile application which solves the drawback of current public transportation system. So our system handles all the data like real-time location of bus, management of buses, arrival and departure timing for all buses, feedback system which will help for data analysis, cost estimation, future prediction of transport system.

The implemented System architecture has Three Modules:

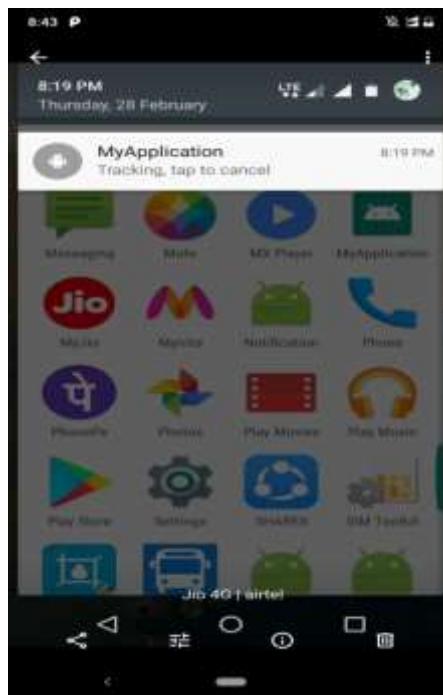Fig 2. Track-O-Bus System architecture

Tracker Bus module:

Fig 3. Tracker Bus Module

Login and access to Conductor and Driver module of the travelling bus system which will start and stop the trip from one bus station to another bus station.

Administrative Control of public transportation system:

Administrative module with proper login and password is provided which can trace out all kinds of bus activities along with data analysis in the firebase database system.
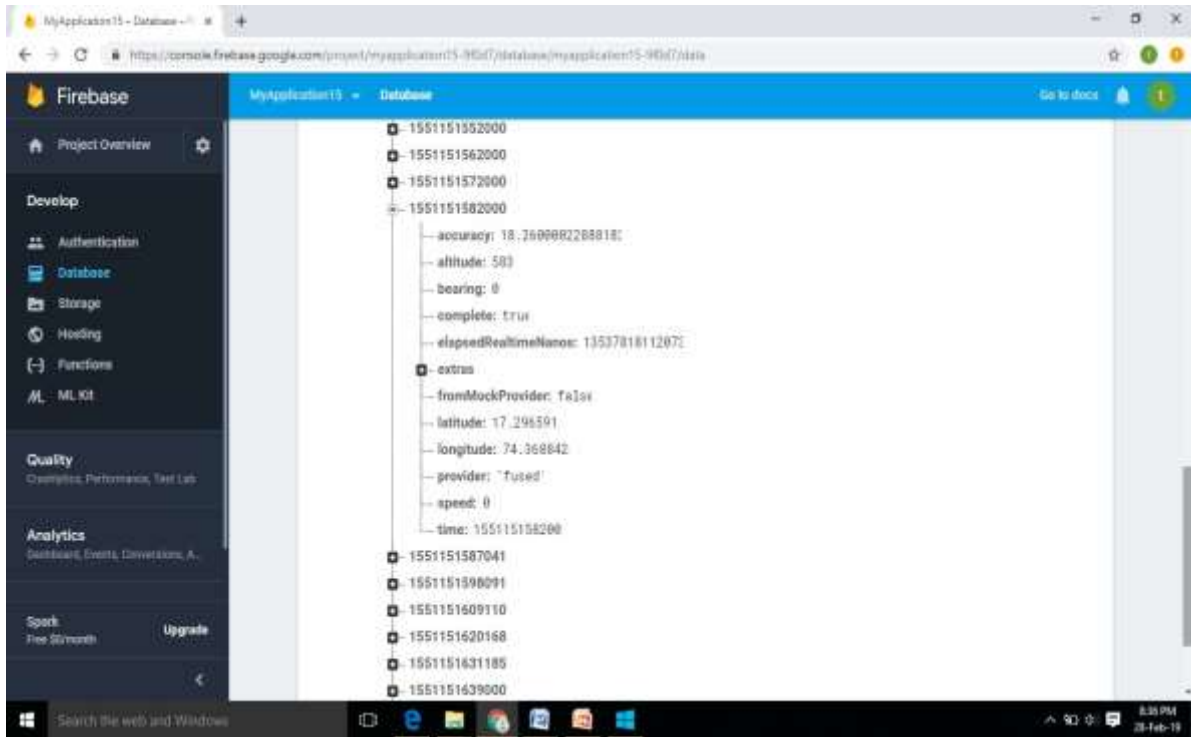
Fig 4. Real-time data analytics for each bus
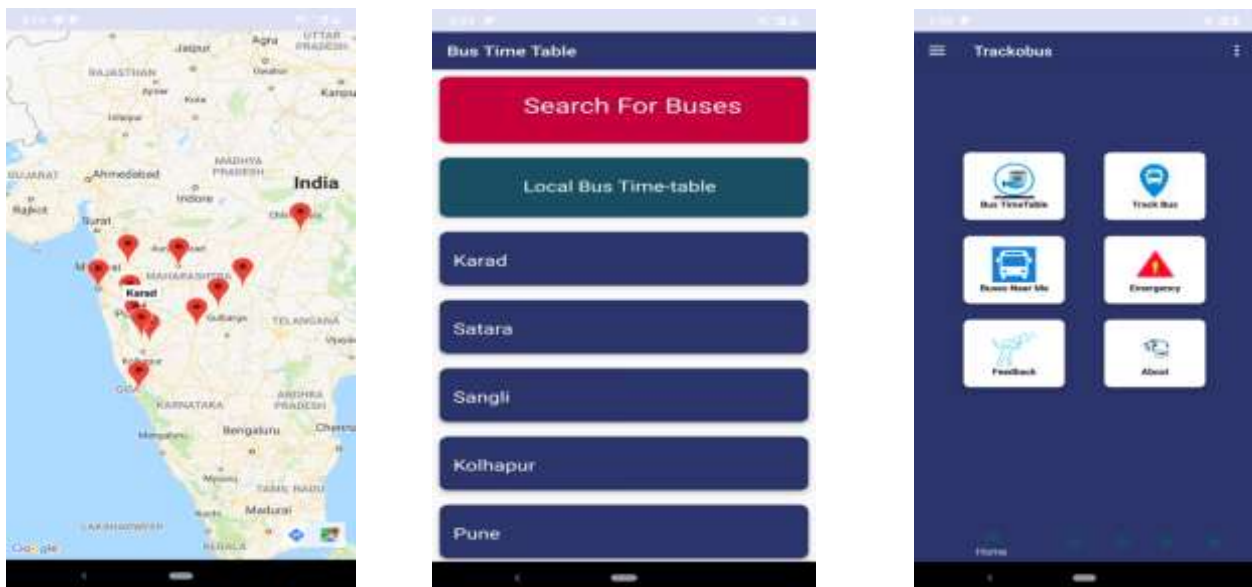
Track-O-Bus application:

Fig 5. Track-O-Bus Implemented system

A Remote user module i.e. end user has a login with real-time bus location, bus arrival and departure time and all the bus information. The "Track-O-Bus" is a display android application uses various techniques for location tracking of bus using Google map API's without using any physical IOT models like sensor, arduino etc.
The detailed architectural implementation involves:

Frameworks:
- Android Studio V3.0.0 or higher
- Google Firebase

- Google Map API

Language/Technology:
- Java/Kotlin
- XML
- HTML 5
- JavaScript
- Angular JS
- Node.js
- JSON
- Python
- Machine Learning Algorithms
- Google Data Analytics

Global Positioning System (GPS):
The GPS is structure of 35 or above well-equipped satellites that stays at the earth's orbit which can accessible for people on ground to track find their geographic location. The location accuracy is 100 meters to 10 meters.

General Packet Radio Service (GPRS):
The GPRS allows 2G, WCDMA and above mobile networks to transmit IP packets from source to destination as an integrated part of the GSM network switching subsystem.

Google Map API:
Google API is a cluster of application programming interface (API) introduced by Google which allows communication with Google platforms and their integration which helps for building different software applications. The Google Maps API's can be useful for Android, iOS, HTTP web services, web applications and helps for real-time location tracking of mobile vehicles and applications.

API Key:
An API key is an advanced, unique identifier that generates a code which is passed by computer programs calling an interface to identify the calling program, its remote user to the application. Each time there is need of an API key to validate your request using the Google Cloud Platform Console.
The Google map API works in co-ordination with Google Transport tracker system with help to find real-time location of bus with android mobile system.

V. TRANSPORT TRACKER

Transport Tracker is unique technique to keep the eye on mobile assets like buses, vehicles. An Android app traces the location of bus and stores it in a Firebase real-time Database. A map platform built with the Maps JavaScript API provides real- time tracking of your buses, routes and schedules.

Transport Tracker system consists of following components:

Storage of data:
A Firebase is real-time Database that generate and stores the vehicle locations, snapped to the road with the Roads API which provides synchronization to the backend i.e. Firebase database.

Vehicle Tracker:
An Android app that uses the location provider, in the Google Play services location APIs, to report its real-time location to the Firebase database.

Database:
The backend system is using Google Firebase as a database system. The backend is built with JavaScript, JSON, Node.js which tracks location from the Firebase real-time Database and predicts travel times using the Directions API. Firebase is a database platform for building Android, IOS, Web applications. It offers real time database, data storage, user authentication, static hosting, Performance, crash reporting, different APIs, multiple authentication types and hosting platform, Google Analytics, Cloud Storage and much more.

Google Map:

Google services like Map API's are used to develop real time location visualization and statistics . The android application uses the Maps JavaScript API to display a styled map showing the bus locations and routes.

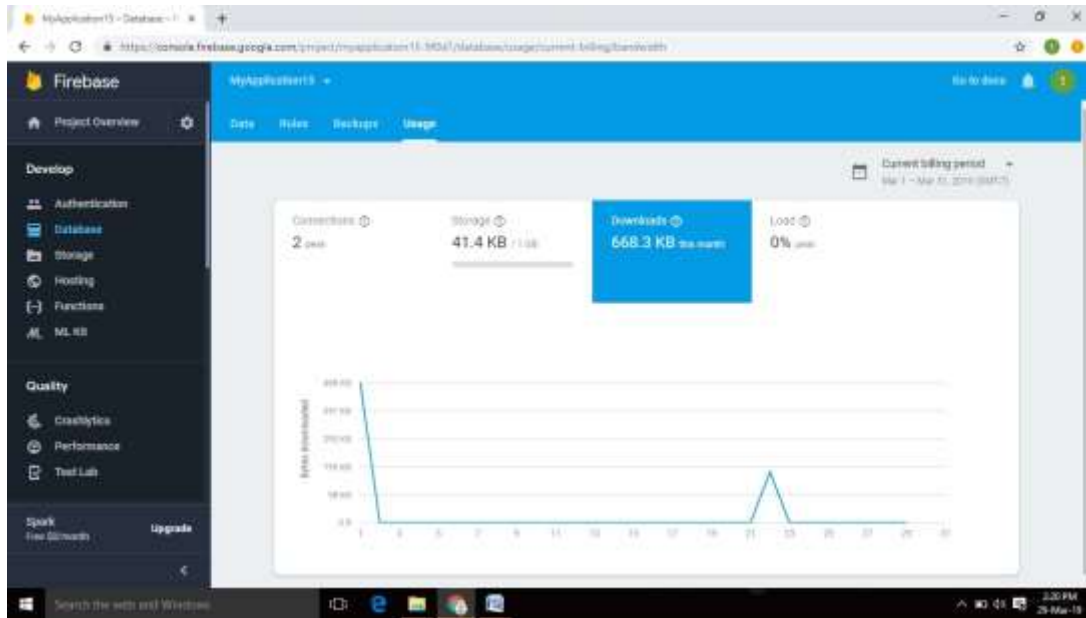Using ML for Google Data Analytics:
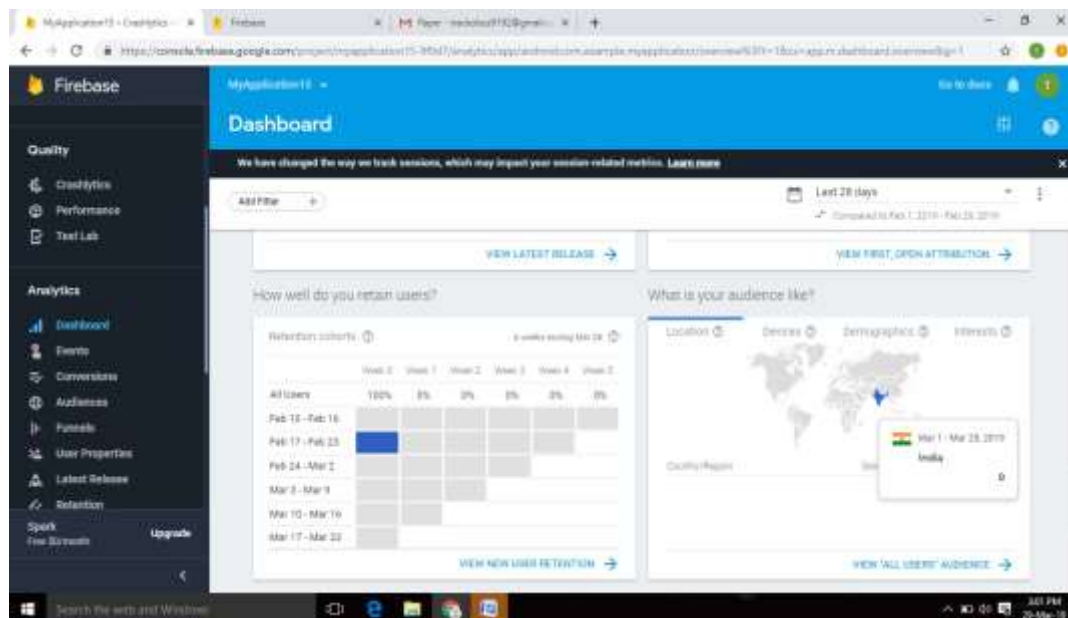

Fig 6. Load and Usage Analysis

Fig 7. Google data analytics using ML algorithms

A visual interface for administrators, giving an overview of the assets being tracked. It displays various dashboards using the machine learning algorithms like KNN, regressions, SVN, Decision tree, deep neural network and provide vehicle and location data from the Firebase real-time Database. The administrator will get to know about all the bus activities including real-time bus location, time and distance required for bus to reach the destination, arrival and departure of the bus, any complaint about bus management, any failures in bus, and bus environment.
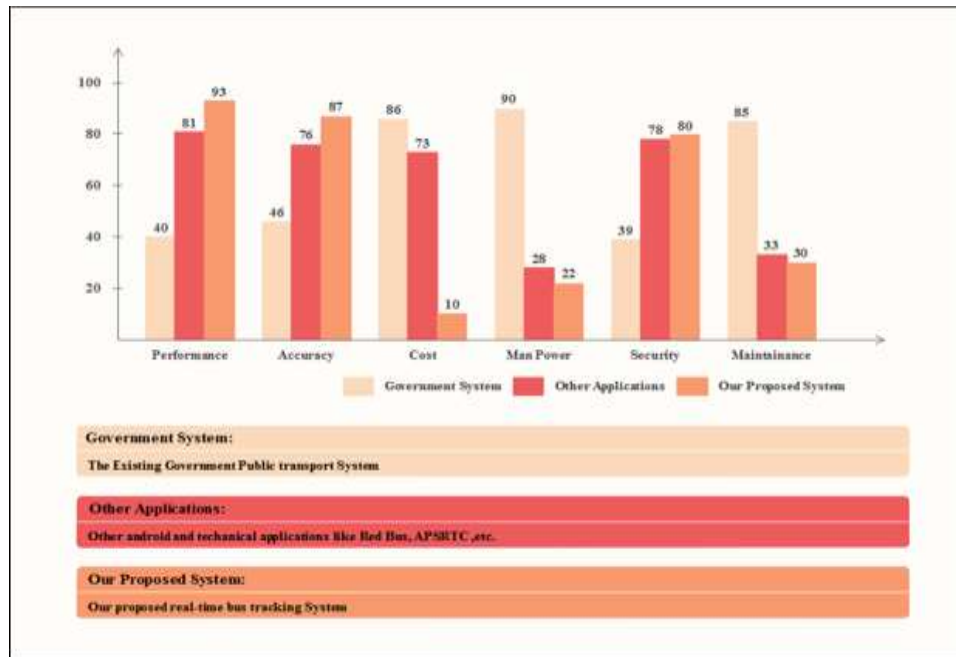
VI. PERFORMANCE OF IMPLEMENTED SYSTEM

Fig 8. Comparison with existing system

The benefits of implemented system over existing system:

- The existing government transport system still works on pen-paper and handwritten documentation.
- There is no specific administration level management for the existing system.
- Other applications and private technologies like Red-bus, APSRTC charges cost for bus details which are not essential for our proposed system.
- The exact real-time location, statistics and analytics is possible by implemented system.

VII.   CONCLUSION

Machine learning and deep learning algorithms improves the effectiveness and overall performance of existing transportation without any extra hardware deployment. It is having low cost maintenance and wide future scope. Track-O-Bus system is helpful to keep a systematic track of all buses and analysis for present and future advancement. This system also throws a light on the frequency of the buses on the same route. The features of these systems are the efficient usage of time, real time and updating information on the availability of buses, route congestion acknowledgment, and commuter satisfaction. Real-time location tracking of the bus, continuously updating data of the bus time table and estimation of departure and arrival time of the buses are main expected outcomes of this application.

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BIOGRAPHY

The Author is currently working as a software engineer and a cyber-security analyst at Infosys and has technical experience of working on real time cyber security projects and AI, ML programming. The Author has completed Bachelor of Engineering (BE) in Computer Science and Engineering from DACOE, Shivaji University, India. Author has sincere interest and work portfolio in machine learning, Artificial Intelligence and cyber security.