Designing IoT-enabled Dynamic Fleet Management Systems for Autonomous Vehicles with Human-Centric Authentication

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1. Introduction

Currently, many Internet of Things (IoT) data exchanges are insecure, opaque, expensive, susceptible to fraud, or prone to error. One approach to improving the trustworthiness of this data and communication is through blockchains. We introduce a new set of connectivity service options that define two broad categories of services. The first is AVs engaging in a direct peer-to-peer connection to each other using a range of technologies. The second is the establishment of a link to an access point (wired, fiber, or wireless, such as Wi-Fi/DSRC/5G/4GLTE) connecting the AV to each other as well as dynamically to other access points.

Autonomy in vehicles is poised to revolutionize the transportation sector. In the dynamic fleet management system for AVs, there are two main techniques demanded: AV to infrastructure communication and the reliable peer-to-peer communication amongst AVs.

Designing IoT-enabled dynamic fleet management systems for autonomous vehicles with human-centric authentication blockchain enabling trust in IoT autonomous vehicle (AV) use cases. Deployment models for AVs, characteristics of connected AVs, IoT-enabled dynamic fleet management system for AVs, system architecture, business rules, information model, security model, finer design of symmetric vehicle and asymmetric operator keys, certificate ontology, random number generator, imperfection distribution, deriving the imperfection addresses, secure pairing-based vehicles and operator authentication, evaluation, conclusion, future work.

1.1. Background and Significance

Recent research on Autonomous Vehicles (AV) addresses current and new challenges, aiming to create a stable and streamlined network for different applications, as well as the provision

and management of various services. The adoption and application of Intelligent Decision Making Principles in Autonomous Vehicles is essential, where a Fleet Management System (FMS) is necessary to provide a loaded exchangeable Intelligent Decision Making System scenario supporting each vehicle. To manage the fleet and support the applications sustaining contemporary smart cities, different vehicles with their own sets of available Intelligent Decision Making algorithms work according to specific operational requirements based on diverse user applications. To the best of our knowledge, we propose herein such a model in the Human Centric perspective, in relation to the direct relationship between users and the services executed by the vehicles of the FMSArc model. The contribution of this research paper to the domain of Digital IoT city architectures is therefore at greater depth.

The IoT concept can be simply stated as a dynamic global network infrastructure with self-configuring capabilities, which connects physical and virtual objects. At present, there is no clear consensus on a definitive definition, or a clear corresponding set of definitions in application areas. The concepts are closely related to both the theory of ubiquitous computing, which aims at communication possible anywhere, by anyone, with anything, and the communication through technology fields, which include the ubiquitous information society, suggesting that societies will reach this stateless status. The growing usage of intelligent devices, from healthcare to smart cities and transportation, has advanced the concept of smart cities using the IoT for a smarter infrastructure. The transportation and logistics sector embraced innovations based on IoT concepts by introducing self-monitoring and self-maintenance vehicles, leading to a new concept of an Autonomous Fleet Management System.

1.2. Research Question and Objectives

In this paper, we address the question of what the design characteristics are of IoT-enabled dynamic fleet management systems for autonomous vehicles that encourage the human-vehicle interaction and the public adoption of such systems. To that extent, we examine researchers and practitioners as the 'builders' and 'enablers' of IoT-enabled systems, and the hypothetical end users of the proposed systems. Only with such underlying human constructs, the proposed IoT-enabled dynamic fleet management system can drive towards a broad social adoption. Furthermore, by considering a plethora of IoT-related design paradigms and human-centric authentication approaches, we propose a socio-technical design framework (STDF) that integrates across multiple levels of human needs and media

choice factors in the user authentication process. This framework provides four primary-level considerations along with the relations and interactions between multiple design paradigms and user needs, i.e. it offers insights about how such human-centric authentication paradigms rely on balancing functional (cognitive and motivational), relational, transactional, and strategic user needs.

2. Fundamentals of Dynamic Fleet Management Systems

The levels of automation have led to the development of different fleet models that vary in the frequency and type of interactions that the network operator has not only with the vehicles but also with the transportation automation, the industry, and the customers. The main envisioned scenario for transportation is traveling with an automated fleet or flying taxis. In this paper, we examine the design of a communication system that allows a public transportation mode to have dynamic scheduling based on the estimated demands for the service and the actual locations of the fleet. Public transportation requires the design of a dynamic fleet management system that is non-fully autonomous and requires close human-in-the-loop operations to address the variability and changes in human demand during the day.

Dynamic Fleet Management Systems are communication and computation systems that supervise and operate efficiently large fleets of autonomous vehicles conducting transportation operations. Services that are fully autonomous do not require human intervention to operate. If services allow for human operators to intervene when the automation needs assistance, then the services are called non-fully autonomous or human-in-the-loop. If either the assistance that the human operator provides is frequently required, with small latencies, or the human operator continuously interacts with the automation, then the transportation service is considered to be human-centric. Examples of human-centric operations include platoon management, convoy management, but also public transportation and rental cars that need a human operator to fuel, charge, or clean the vehicles.

2.1. Overview of Autonomous Vehicles

Autonomous vehicles are not only intelligent systems interacting with the physical world and the environment. These entities are also Internet of Things (IoT) systems because they are equipped with numerous sensors and actuators used to analyze, inspect, diagnose, interact,

control and make action over the physical world and the environment hands-free and at a distance. Autonomous vehicles can communicate with the physical world and the environment to collect data and information, access data and information from the cloud, send data and information to the cloud, extract, integrate, analyze and transform data into information and insights, use these insights to make decisions, take actions, perform tasks, and develop procedures related to business processes, operational processes and models based on what works best for the mission, operation or activity's current condition, situation or behavior.

In recent times, within academia and industry, autonomous vehicles have been generating considerable research interest because of their possible wide-ranging impact on various applications. Owing to the capabilities and the advanced features of the vehicles, such as sensor mapping, collision avoidance system, control system and actuation, it is feasible to deploy vehicles for reducing the human effort to perform tasks and operations such as wide-range search and rescue missions, measuring radioactivity and toxic gas leaks from a safe distance, firefighting and transferring injured people to safe recovery, various goal-oriented missions, agricultural activities, supply chain management, dynamic fleet delivery management and post office distribution, industrial operations and activities, and transport and logistics activities.

2.2. Key Components and Technologies

At the software level, the perception system receives inputs from multiple sensors and interprets the environment to localize the vehicle and understand the objects, lanes, sources, and destinations around it in the geometric plane. The traffic planning functionality differentiates dynamic local maneuvers from high-level navigation. At the device level, the vehicle would have several on-board networked processors for sensor data processing, data storage, and internet access. Furthermore, the AVs require an on-board data processing and computation infrastructure to process real-time needs such as converting control instructions into physical steering, acceleration, and braking, route planning, vehicle status monitoring, and contextual message conversion. The cloud-based services will have storage, IoT platforms, real-time streaming sources, real-time event handling, voice orchestrations, cloud applications, and business process APIs (REST).

The key components of dynamic fleet management systems are connected autonomous vehicles (AVs), computational infrastructure within the vehicle, and cloud-based services in the backend. The AVs should have various types of sensors such as LIDAR, RADAR, camera, GPS, and vehicle-to-everything (V2X) communication modules in the hardware plane. The Light Detection and Ranging (LIDAR) sensor uses laser beams to collect data on the surroundings of the vehicle to create an environment map. The RADAR sensor communicates with other vehicles and obstructions. The camera sensor records and reads traffic signs, traffic signals, and navigational aids to self-drive through dense urban and suburban traffic. The Global Positioning System (GPS) sensors communicate with satellite constellations to continuously provide position, velocity, and time information of the vehicle. The V2X wireless communication module sends and receives basic safety messages via cellular and 802.11p interfaces to enable vehicle-to-vehicle and vehicle-to-infrastructure communication.

3. IoT Integration in Fleet Management

Dynamic fleet management systems (DFMS) in the AV context is aimed at managing a set of system interaction and control decisions in order to cope with the transient (and occasionally uncertain) nature of AV demand due to spatial and temporal variations in how trips are demanded and consumed. These span from macroscopic "big" decisions related to the optimization of an AV fleet in a geographical region, the "tracking" and navigation decisions while satisfying higher demands, and eventually to the local microservice decisions within the vehicle. Ensuring coordinated and "optimal" decision-making across these different time scales, and between potentially different tiers of fleet managers within each AV fleet industry would be of key concern to achieve the expected normal operational service performance, cost expectations, and safety assurances.

In line with the broad Vision Zero and FHWA fleet management goals mentioned in the previous section, dynamic fleet management arising from IoT platformization has further potential goals to minimize the total human driver/task engagement time in a given vehicle, to minimize the total number of vehicle changes/human hassles. In the context of AV and ridesharing, these goals translate to far more radical fleet management systems that should ultimately challenge the very idea of individually owned vehicles. Indeed, the incoming digitalized-automation wave can set a vision of each group of individuals across shared geolocations owning exactly as many AVs as are needed on average for the group, instead of

the individual ownership, leasing and similar paradigms in practice today. For the remainder of this paper, we focus specifically on the domain of AV fleet management.

3.1. IoT Architecture for Fleet Management

Finally, the known software and hardware capabilities are featured on the last layer while exposing the data repository as a published capability in our design.

The technologies and tools developed for layer three include dynamic methods to globally select an efficient edge service from a diversity of edge nodes. On this layer, service matching played an important role in the design of system functioning. The service matching functionalities, by employing different technologies and strategies, are available on different service scenarios, or a combination of more than one scenario running simultaneously.

Humans' consent including deployment, withdrawal, and duration on the IoT fleet platform is the most important concern when implementing an IoT production service that converges with both IoT technology and a practical business model. The technologies and tools developed for layer two include multiple dynamic service models to serve autonomous vehicles in a dynamic fleet. Note that those services are included in the business model abstraction, and tailored to the requirements of autonomous vehicles.

The proposed architecture consists of layers that differ according to function while providing a tiered structure driven by the business model. The layers, from top to bottom, are presented as follows: human-centered aware and consent layer, autonomous vehicle service logic layer, edge service logic layer, and IoT capabilities layer.

In this section, we describe an initial version of the IoT architecture of a fleet management system, by taking the system prototype of our project that followed a real PaaS for IoT platform. The architecture of our IoT-enabled fleet management system is proposed based on our previous research in merging IoT with PaaS.

IoT has been considered as one of the enabling technologies for dynamic and flexible service coordination. Many technologies and tools have been developed to facilitate IoT network deployment as well as using IoT as a business. The implementation of an IoT-enabled fleet management system is critical for not only enabling fully autonomous vehicles due to the

cooperation of multiple vehicles as a fleet, but also for the apt communication between autonomous vehicles and humans.

3.2. Benefits and Challenges

However, there is still a new set of challenges being brought into the fleet management domain by the demands of autonomous vehicles. Such challenges include dynamic management of autonomous vehicles, human-robot interaction issues in fleet management systems, and research gaps in existing commercial fleet management issues. In addition, the new emerging health awareness concept of licensing the fleet access after a human-rationality utility calculation based on brain-computer interface (BCI) calculations adds another dimension of effectiveness consideration.

Fleet management involves improving the productivity and mode of operation of a delivery service, which is typically a large number of trucks, buses, or taxis, to satisfy customer requirements. Dynamic fleet management is the use of IoT to collect, share, and analyze vehicle data to handle unexpected situations. The main responsibilities of the dynamic fleet management system include making in-time decisions based on changing events and managing the system in a cooperative way, rather than based on pre-established and inflexible rules, to provide on-demand and time-critical services to clients. In addition, by leveraging the big data from IoT, the dynamic fleet management system can inject intelligence in the decision-making process. It can provide information such as optimal route selection and appropriate vehicle selection for smooth and cost-effective delivery services and provide the measures to manage risk for fleets such as idleness avoidance because of traffic congestions or traffic accidents.

4. Human-Centric Authentication in Autonomous Vehicles

Several studies underline that user interface (UI), design, and the interaction experience play a major role in the acceptance journey. Human Factors, Human-Machine interfaces (MMI), and Vehicular User Interfaces (VUI) are crucial aspects in AV design. In particular, the majority of studies show that users welcome UI and VUI elements that are designed to provide transparent communication about the capabilities, intentions, and operational modes of the robot. Ethical aspects, trust, and risk perception level are also important. The paper shows how the proposed strategy is moving in this direction, introducing a vehicular user

interface that was inspired by the moral concepts present in our society and engages the user in the decision process of self-driving cars. Sako et al. proposed a 2D user interface design for in-vehicle use by pedestrians in a further development of its original work that furnishes an interface for passengers to propose and withdraw a ride-sharing request in a multimodal private vehicle. They designed MMI based on the five levels of interaction, i.e., dialogue, gestures, voice, gaze, and touch, and report on the outcomes of a realistic scenario-based user experiment. The authors of the paper propose solutions that support particular interaction modalities and that draw users into dialogues pertaining to decisions that should be made by an AV.

The arrival of novel types of services in the IoV era is changing the way people and vehicles interact. Autonomous vehicles are a major development in vehicular evolution. AVs have a significant potential impact on the reduction of traffic congestion, accident frequency, lane capacity, parking space demand, and fuel consumption. In the future, personal AV becomes a real alternative inside cities, especially in multimodal mobility scenarios. In a few years, riding an AV to move from home to the station and then departing to another city by train might become the most convenient solution. Nevertheless, the degree of trust in the technology is still low and it changes between cultures. According to the Boston Consulting Group, the majority of Europeans do not want to share the road with robotic vehicles.

4.1. Authentication Methods and Technologies

Different problems occur during the authentication process in a vehicle environment. Such problems are not limited to environmental problems, while others are related to different methods to authenticate specific contexts. Traditionally, RFID and tokens are utilized to provide the access control process, yet, RFID might encourage some serious issues that include eavesdropping and tracking by unauthorized entities. Thus, different authentication methods and technologies are suggested to solve the predefined problems such as cutting pseudo-redundant vehicles and offering a complete security policy for the authorized vehicles. By this method, less secure keys are not utilized for locking on-board systems. Furthermore, the paper will cover the following parts: "Identification, authentication, and authorization" and "Biometric identifiers".

4.2. Human Behavior and Preferences in Authentication

In order to present the concept of Implicit Authentication (IA), we present a representative trip scenario. After the vehicle assigns the Awareness Factor Function (AFF) to the vehicle, the location is obtained through the location model-based method. Data concerning the seat, seat belt gear sensor, weight sensor, steering wheel, brake, and engine pedals, the temperature, illumination, the presence of a portable device, the human face, and the passengers + driver are used to automatically determine the ID, priority level, access rights, and operational preferences of any passenger. Since the onboard seat belt sensor should support occupancy recognition, some of the existing perception addresses are obviously seated in the passenger seat.

An individually customized cabin setting and vehicle environment are automatically enabled once seated; this feature, in conjunction with human behavior, can permit the establishment of an implicit owner before the vehicle. The technology will allow personal passwords or pins backing the explicit or the implicit process, thereby permitting each one's personal profiles, preferences, and data, after which the conscious authentication process is routinely waived.

Once seated, users would generally expect to be treated as the primary person for a duration while occupying the vehicle. The need to experience the full capabilities of the luxurious interior, perform personal, professional, or leisure activities, or simply take things easy is likely to be the prevailing interest. Requiring authentication will amount to standard security protocol practice purely for the vehicle's safety, primarily for insurance purposes, reserved mainly for potential negligence, the inability to perform otherwise unauthorized services or requests, and for establishing individual profiles or service billing facilitation.

Our work assumes that the convenience typically associated with autonomous vehicles is likely to both suppress user willingness to authenticate frequently and desensitize the users towards persistent location beacons. It is expected that the generation of passwords or keying of pins is going to be increasingly perceived to be a relatively unnecessary, time-consuming, and redundant chore when sealed off in the secure space of one's privately or shared automated vehicle. Consequently, users' level of willingness to authenticate using reminders based on prompts or visitations may not be entirely characteristic of users' actual desires or attitudes.

5. Design Principles for Secure Access Control

Autonomous vehicles (AVs) are embedded systems consisting of cyber-physical components, sensors, actuators, and communication systems that receive their direct mission objectives from humans or from automated systems, without real-time human intervention. For the future use of AVs to be successful, managing the fleet in a dynamic manner will be more important than managing single vehicle operation because the structure of the operation is much more complex for AV fleet management (AVFM). For successful AVFM, access control security should be part of the design considerations provided by human-centric authentication methodologies and hardware components. This will make proactive secure integration of AV fleet operational activities throughout the lifecycle of these fleets possible. In this chapter, we present design principles for secure access control based on AVFM tasks, in which user intent embedded command intelligently operated vehicles (IOVs) with human-centric authentication. These design principles will be used to build an initial foundation on which to develop a system for proactive secure access control of AV operational tasks in the presence of passengers that need access to the Internet of Things (IoT) ecosystem of the vehicle.

5.1. User-Centered Design Approach

Our approach is user-centered, where the focus is on the design and performance requirements derived from a detailed interdisciplinary understanding of the anticipated users, and a concern with real-world performance and productivity. Our methods draw upon techniques from visual analytics, ethnographic observation, formal experiment, and participatory design. In each of these methods, we aim to recognize and draw commonalities between the tacit knowledge of air traffic control professionals and similar experiences reported in the literature. The diversity of these methods was necessary to draw out new insights that could not be observed through any single method alone.

In this section, we describe our user-centered design approach. Our goal in this phase was to capture the needs and behaviors of the users of our interest in using the air transportation systems and specifically the dynamic fleet management systems in all the steps from the point of looking for available carriers and their status. Both qualitative and quantitative methods were employed during the data collection, and visualization technique was employed to analyze the collected data. Throughout our description of the methods used, we will provide design implications in the form of requirements.

5.2. Adaptive Authentication Models

Adaptation can also occur in the policies' physical identification component where the level of strength used to validate a user depends on the environment. In the presence of a real risk of MITM attacks, and consequently, the possibility of setting administration mode, by default, in a stronger relationship, robust authentication means need to be adopted. Contrarily, a compromise between the level of security and the costs generated in weaker relationships can be accomplished with an intermediate authentication method, such as a password challenge. Finally, in environments with no record of MITM victimization, the utilization of the QR code (for which only a device with an active camera is necessary) is a good trade-off. The policies' behavioral identification component can also provide behavioral biometrics by collecting and analyzing information to classify users into groups and distinguishes between usual and unusual behaviors. Any sudden change in this pattern can be an indicator of impersonation.

Also driving the learning object and ontology agent, adaptive models can be used to build user profiles, which serve as a foundation for the sharable context. By analyzing user-related information and inferring user preferences, requirements, and characteristics, the ontology agent comes a step closer to understanding and representing the human-centric characteristics. These models can also be used to learn and adjust the authentication and authorization models to the users' behavior throughout their employment life within the organization.

6. Case Studies and Applications

The application of an Internet of Things (IoT) enabled vehicle depot management system is presented, and this model is used to manage AV shuttle fleets. The application's basic function involves a vehicle depot, which is particular in the context of shuttle movement between two buildings. From the depot, vehicles would have to move from one of the buildings to the other, while making a few stops on the way. While moving from one building to the other, another part of this application would allow park-while-charge zones to do a handshake with the vehicle to ensure that a desired parking/charging state of the vehicle was reached. Since the AV shuttle not only moved to convey people, but also moved to get recharged at a specific stop and was not operated at night, the idle waiting time and the cost associated with the shuttle operation were low. Hence, Capgemini's 'Reva2Parichay' became an attractive AV shuttle service use case for practical implementation of human-centric authentication based

on commonly available smartphones, which could also be downgraded to the existing contactless smart cards. To achieve this, the specifics of the low-cost dynamic fleet management application with operational constraints comparable to IoT-based services were investigated based on the data collection effort of the Reva2Parichay team.

The second example is a practical implementation of an AV shuttle service on the campus of Capgemini World Technology Centre, an office location in Mumbai, India. The service is named 'Reva2Parichay' and operates hourly between two buildings on the campus.

In this chapter, two dynamic fleet management systems are presented. The first is a qualitative case study of an autonomous vehicle (AV) shuttle from a dataset involving Microsoft Corporation, who tested the AV shuttle service for its Redmond campus. AV services to transport people between buildings in large corporate campuses can greatly aid employees, particularly those visiting for short durations, by having a ready AV shuttle service available for them. The shuttle is expected to have no drivers, operate within a regular operational time period, and be managed within the campus. Although there was a human bus interface, the operations on the shuttle, such as boarding, trip initiation etc., would be an autonomous function.

6.1. Real-World Implementations

As shown in Fig. 18, SAGE operates in the following way for the used scenario. When the incoming user approaches his final destination, he states his intent to use the SAGE service via his mobile client. SAGE uses information about the user's avatar position and the available parking spots to decide who to pick up. The incoming SAGE vehicle guides the parking user to their final parking spot. When there, the user's mobile device recognizes the parking service area. He can voice-activate SAGE remotely, and the vehicle will navigate to the designated position. SAGE is now ready for use by a new parking user. The use of several vehicles allows SAGE to scale its capacity. SAGE can also assist electric vehicles in recharging operations, e.g., when their service goal is on the water, itself operating partially on electrical energy.

In this section, we discuss the real-world implementations and design considerations for autonomous vehicles in dynamic fleet management solutions in the context of human-centric authentication with IoT-enabled capabilities. We utilize a parking scenario where the SAGE vehicle serves as a parking guide for the incoming AV user. The guide can not only find the

optimal parking spot but also choose flexibly between several parking options. We discuss the real-world challenges in the practical dissertation of using SAGE in the scenarios.

6.2. Use Cases and Scenarios

The main use case scenarios that employed human-centric authentication support a number of operations in typical smart city presentations. These scenarios utilize dynamic operational data from corporate fleets (e.g., bus operator, cargo operator, taxis) to make decisions. The addition of human-centric verification of intent enables appropriate on-board and remote processing of IoT-generated content and the decision-making process concerning the potential modification of vehicle functions. In addition to the standard procedures necessary for the operation and maintenance of cars already provided by service providers, the implementations of the proposed process are feasible. Human-centric verification expands the coverage of the verification system to mitigate privacy and anonymity concerns (e.g., GDPR, e-privacy impact). In more privacy-sensitive applications (e.g., tracking or community-based infotainment), it is possible to visualize only approved content while providing decision-making information.

The proposed HCA (Human-Centered Authentication) approach is employed in fleet management scenarios where human-driven fleets are gradually transforming into AI-driven fleets, where fleets are viable for certain tasks without being directly driven by humans. The system may be alerted to the human drivers' propensity to switch drivers in various geographic areas during special events (e.g., sports game), during festivals (e.g., music festival). In mass transit, IoT (Internet of Things) devices in buses or trams, and holding areas (bus stations, tram stations), may detect power and data congestion in the vicinity and help manage the transit system so that vehicles intervene at the right place at the right time. The clustering of the population at specific points in the city and the combination with the other parameters of the area's network are valuable information for traffic management, but also for service management.

7. Future Trends and Research Directions

However, the future vehicle fleet features a dynamic environment. For example, the expected rise in fuel prices poses operational challenges and changes in the operational dynamics of vehicles. Moreover, emerging automotive technologies also introduce vehicle and driver

attractiveness into the management policies of vehicle fleets. Therefore, the fleet management system must be designed as a dynamic system that can manage a given number of service requests under a given operational budget while maximizing the quality of various vehicle services, taking into account the dynamics of the vehicle fleet. Future vehicle fleets will also feature human-centered autonomous vehicle (HCAV) models. The user-centered design trend in interactive technologies has recently expanded to HCAVs, aiming to build a user-centered autonomous vehicle interface system for vehicle owners, as well as passengers. Many studies have proposed methods to estimate real-time health information of drivers and passengers, interpret vehicle users' feedback and emotions, and prevent rumors about HCAVs. However, few studies have aimed at integrating HCAVs from the perspective of fleet management. This reveals that no efficient dynamic fleet management system is available that can provide the personalized vehicle service required by HCAVs at different operation time periods. The challenges and research opportunities in designing an explicit vehicle fleet management system to dynamically fulfill various autonomous vehicle services under user-vehicle interaction are the current research focus.

In recent years, with the advancement of automotive technologies, many vehicle fleet management systems for autonomous and connected vehicles have been further developed, directing toward autonomous driving and optimized fleet management. Moreover, next-generation vehicular networks will enable vehicle-to-anything (V2X) communications between autonomous vehicles, roadside units, and central cloud servers. To achieve both advanced driving and intelligent fleet management, vehicle cloud servers need to provide various vehicle services, ranging from autonomous driving, electric vehicle (EV) charging, route recommendation, and real-time service updates with vehicle navigation, to integrated personal assistants based on the vehicle users' preference profiles, behaviors, and schedules. Thus, vehicle fleets enable multiple types of services that result in a large number of requests from different users with various vehicle service preferences. The vehicle fleet management system must provide optimized service quality to significantly improve vehicle utilization rates and user satisfaction for both vehicle owners and service providers.

7.1. Emerging Technologies in Fleet Management

Several market designers have reported that, when drivers get a benefit from misuse, the unintentional loss occurs. This driver loss has presented a criterion of motivation for the rise

of unauthorized different types of actions at U.S. borders. Unauthorized actions or bad behavior are divided into many categories. By distinguishing three separate kinds of unauthorized actions, the operator theft may obtain a better understanding of how to decrease theft. Unauthorized actions are permissive or deliberate; this action has a corresponding cost in the probability of being penalized under the deliberate. Drivers may act differently in the period during which the contract is in helping close association with the operator. The international operator in 2012 actively supervised stealing Information about the probability of being penalized that enforced 10,181 U.S. border transport restrictions through vermicelli, collection, technical service, and can very fast communicate penalties.

The scope of fleet management systems has changed in recent years due to the introduction of smart technologies, urban dynamics, mobility, and the rise of Internet of Things (IoT) for seamless inter and intra-vehicle and roadside communication as well as the automatic identification of drivers to authenticate their credentials. IoT-enabled varied dimensions of intelligent fleet control, accessibility, scheduling, overall improved operational planning, increased safety, and environmental aspects need more investigation and improvement in the context of upcoming autonomous vehicles (AVs). Climate change, road safety, and human-centric issues are mainly concerned issues even with these highly sophisticated systems. In the upcoming era of intelligent transportation, in addition to the existing problems associated with logistics operations, enforcement of driver-related regulations is also a considerable challenge that is being complicated by practical misuse or the theft of smart modalities. Enterprises, traffic regulation agencies, drivers or Internet of Vehicles (IoV), and voice are the main stakeholders involved in the context of the future Autonomous IoT-Era Smart Fleet Management System (AISFMS).

7.2. Potential Innovations in Authentication

In this section, we discuss the potential innovations on authentication that can be realized using our proposed human-centric embedded sensors.

In general, there are benefits associated with a vehicle, such as automatic preparation for user riding. And it is along this line that several methods of identification or authentication are researched. By investigating the limitations of conventional methods of identification based on physical construction and a history of electronic or networked services, development of an

appropriate, more convenient, and a more understood identification model or method is expected to contribute.

Unmanning vehicle services could remove the use of physical keys or remotes to start a vehicle. With this, it is possible to reduce the barriers and make vehicle services easier. However, there are security concerns, such as improper use, theft, or unauthorized remote operation by someone else. For example, unauthorized restart of the engine or television operation when the user has left the vehicle.

In shared vehicle systems, finding the correct vehicle from among many that are present in a parking lot can be non-trivial. A human-centric authentication based on proximity to the vehicle can provide the user with location-based feedback about the vehicle. Unmanned services that require manual intervention rely heavily on identification of the person to authorize action.

Dynamic fleet management systems for autonomous vehicles present a unique opportunity to innovate on human-centric authentication. Given that vehicles are no longer dedicated to only one individual, when an individual comes in proximity to a vehicle or decides to use a vehicle, it may be an appropriate point to decide if the access is really desired by the user. And with the advancement in display as a medium for communication, the vehicle can recognize that this person is in proximity and able to display restricted-use/condition of the vehicle.

8. Conclusion and Recommendations

The following suggestions can be considered when designing a DFMS that features human-centric interactions for fleet optimizations capable of hosting frequent Ferry vehicles or unmanned systems: - Authentication schemes should be seamless, have the lowest possible false rejection rate, and be able to be offered continuously. - Driver communications within CAVs that provide for questions, verification, and system trust can create more compliant users for increased system efficiencies. - An emergency button or function for disengagement represents a clear means to halt operations if a deviation from normal operation is expected. - Tightly managing the authority given to subsidiary systems directly dictating system operation state will allow drivers or table control centers to maintain oversight and control when needed.

This paper proposes a human-centric model for the Dynamic Fleet Management System (DFMS) in connected and automated vehicle (CAV) environments. The proposed system addresses the limitations of previous works, enhancing cyber-physical interactions while ensuring a lower disconnection probability and smaller vehicle idle times. It is observed that frequent Ferry vehicles have human-driven features despite having an autonomous mode that allows them to operate without a human operator. The shorter, relatively distinguishable sporadic exposure time when the human operator is present and physically engaged with the vehicle system is what makes the two systems similar. That active engagement must be designed with the intent to make human presence a valuable component for driving efficiency, security, and trustworthiness.

8.1. Summary of Key Findings

- Due to the increased use of IoT technologies in enabling the management of data generated within these systems, autonomous vehicles are susceptible to security attacks from outsiders. The research illustrated how a human-centric authentication mechanism that accounts for the roles of different users interacting with the system and authenticates their access levels by learning user behaviors such as travel history, patterns of life or habits, individual and group vehicle behavior elements can be used to produce the required actions or decisions in a timely, historical evidence-based and non-intrusive manner. By appropriately implementing behavior and advanced options, it is possible to combat both internal and external attacks for vehicles. The behavior elements should be auto-learnt and updated at specific times in the ticketing system by using advanced technologies, while also allowing the application of a resistive machine learning algorithm which will give a particular level of resources and security levels to defend against abnormal attacks while remaining within cost limits and limits on the parts available in the systems. Without the correct behavior elements the systems could be attacked and infiltrated.

- The application of IoT technologies in the automotive industry is exemplified by the use of dynamic fleet management systems for autonomous vehicles. It was identified in the research and earlier literature that existing fleet management systems used for vehicles may only be adapted for use with autonomous vehicles to a limited extent due to the distinctive features and specific contexts associated with this type of vehicle. This necessitates a re-evaluation in the design of fleet management systems taking advantage of the unique roles users may have

within the system. In addition, autonomous vehicles are primarily associated with the taking of trips and therefore there is no dedicated owner or driver, but users that are spread across different roles using a service type model in the cloud.

8.2. Practical Guidelines for Implementation

Recommendation 1 (Pattern Recognition-Based Authentication): There are various security issues concerning pattern recognition-based human-centric identification and authentication in big data, particularly in IoT. This category includes methodologies working on mining patterns to recognize attackers from protected data or activities, and then developing different means to address detected attackers. At the same time, patterns recognized in biometric data can also be implemented through error detection and correction coding technologies. Pattern recognition-based authentication applications, such as security pattern profiling, spatiotemporal visual cryptography, and unified cellular automata (CA), are critical in big data-based IoT security activities. By using pattern recognition-based authentication in biometric identity management, high security and reliability come within reach. And significant changes in resources saved, huge sensor collection, and real-time data processing benefit the IoT architecture. Deploying more advanced, locally obtained data, which help relate information to both missing data and the smart board, are valuable.

To support the successful implementation of the four important human-centric authentication processes and mechanisms in the proposed DFMS for AV, we provide some practical design recommendations in this section. These recommendations include pattern recognition-based authentication, behavioral biometric-based authentication, gesture-based authentication, multimodal biometric-based authentication, and fault-tolerant design for practical plurality. All recommendations aim to facilitate the development of a truly human-centric DVMS adopted for autonomous vehicles effectively. These recommendations are general and can be applied to the human-centric design of other IoT and data analytics applications as a general guideline.

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