



American Journal of Financial Technology and Innovation (AJFTI)

ISSN: 2996-0975 (ONLINE)

VOLUME 4 ISSUE 1 (2026)



PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Embracing AI and IoT in Building Robust Financial Systems in Ghana: Empirical Tests Using Road Tollbooths and Tertiary Students Fee Payments

Jacob Azaare¹, Zhao Wu², Abubakari Abdul Rahman³, Gilbert Amiisa^{3*}

Article Information

Received: February 12, 2026

Accepted: April 20, 2026

Published: July 30, 2026

Keywords

Artificial Intelligence, Internet of Things, Mobile Money, QR-codes, Tollbooths, Fintech

ABSTRACT

This study examines how the Internet of Things (IoT) and artificial intelligence (AI) stimulates economic growth while guaranteeing convenience and accountability in shaping the financial industry. In a mixed methods approach, we concentrate on driver's road tolls and student's college/university fees payments amid exponential growth in mobile money with a sample of 786 and 688 respectively. This study found that majority of Ghana's public universities/colleges collect fees through the manual bank payment method where students queue in banking halls to pay their fees. Moreover, this study reveals that the government of Ghana canceled the manual tollbooths to reduce road traffic. However, our analysis shows drivers' readiness to support government in revenue generation for good roads infrastructure through efficient and digitized payment systems. This study therefore proposes efficient payments processing through AI with effective connectivity through IoT to ensure robust financial systems in Ghana to fuel economic growth.

INTRODUCTION

A road toll is a user-based charge enforced on motorists for the usage of specific roads, bridges, or highways, designed to recover infrastructure costs, finance maintenance, and manage traffic demand Talpur *et al.* (2025). Different from general taxation, road tolls operate on the "pay-as-you-use" principle, ensuring that those who directly benefit from a transport facility contribute proportionately to its upkeep and expansion. In modern transport economics, tolling is not merely a revenue tool but a strategic mechanism for efficient infrastructure financing, congestion control, and sustainable mobility management, especially in rapidly urbanizing and developing economies. However in Ghana, it would be recalled that, effective 18th November, 2021, the road tolls was abolished by the roads and highway minister given that, the tolling system accounts for the unnecessary traffic congestion on our roads leading to increase in the duration of journeys, which badly affects time and productivity, as well as breeding corruption at the tollbooths (Ahinsah-Wobil, 2022; Mariwah, 2021). Prior to its abolishment, Ghana made an average of 1.8 million monthly from road toll in 2019 (Daily Guide, 2019). Moreover, Tollbooths do not only serve as a source of revenue to the government but also provide employment to many people who are engaged as revenue collectors and those also selling provisions around their catchment areas in Ghana (Dosu, 2015).

Ghana's situation in line with Naaz *et al.* (2020), though tolling points cause traffic jams and increase the duration

of journeys, affecting time and productivity negatively, these traffic jams are fueled by manual road tolling systems. This calls for the need to digitalize the tolling system by integrating technologies such as AI and IOTs into its process.

Additionally, the deficit in innovative Information Technology applications in the Ghanaian economy is not common with only the tollbooths system. Students are equally bedeviled with extra ordinary queues at the banks in their quest to pay school fees and other user expenditures at the tertiary institutions in Ghana. Some universities in Ghana have adopted mobile money payment system to lessen the struggles students go through when paying school fees. However, this process can still be improved by other technologies such as IoTs and AI which have emerged as the current industrial revolution. Siddiqui and Goyal (2023) consider AI as key in offering novel methods in electronic payment processing. Accordingly, the combination of these tools has been done, thus, by instrumenting classrooms with IoT sensors to measure real-time usage and AI to predict attendance, and performing optimal allocation of rooms to courses so as to minimize space wastage (Thanchanok *et al.*, 2019).

Therefore, this paper leverages on AI and IoT technologies in building robust payment systems in Ghana, focusing on driver's road tolls and student's college/university fees payments and examine how they stimulate economic growth while guaranteeing convenience and accountability. Eventually, the study

¹ Department of Business Computing, School of Computing and Information Sciences, University of Technology and Applied Sciences, Navrongo, Ghana

² Department of Finance and Economics, School of Management and Economics, University of Electronic Science and Technology of China, Chengdu, China

³ Department of Information Systems and Technology, School of Computing and Information Sciences, University of Technology and Applied Sciences, Navrongo, Ghana

* Corresponding author's e-mail: gilbertamiisa8@gmail.com

proposes efficient payments processing through AI with effective connectivity through IoT to ensure robust tolling systems in Ghana to fuel economic growth through digitalized-enabled revenue mobilization.

LITERATURE REVIEW

Emerging digital trends are propelling the digital evolution of financial institutions, poised to revolutionize the conventional banking model and usher in a new era of interconnected banks. In initiating the transformation, processes play a pivotal role in digital banking. This analysis seeks to explore the influence of digital trends, fueled by the advent of connected devices, on the procedural framework of traditional banks. In response to evolving customer behaviors, changing preferences, and the abundance of available data, stakeholders within the bank are compelled to undergo digital transformations (Khanboubi *et al.*, 2019).

Anticipated is a substantial expansion in the IoT sector, projecting a global count of 25 billion IoT connections by 2026 (Yalli *et al.*, 2024). This surge in growth will facilitate the exchange of information among objects, fostering communication between them and allowing interaction with users through the Internet and various communication networks (GSMA, 2018). According to Bukht & Heeks (2018), the robust digital financial economy based on IoT will derived a digital model that will encompasses goods and services in the financial sector, in which digital infrastructures are used to control how business services are controlled. This digital infrastructure controls the financial sector and determines the flows of money in the sectors. Nonetheless, the wide nature of digital financial sector ecosystem cannot exist without some kind of shortfalls, which include weak payment systems, lack of skilled personnel to mind existing systems as well as corrupt practices.

Internet of Things and Artificial Intelligence

The Internet of Things has undergone various developmental stages; commencing with the linkage of two computers, followed by the interconnection of a multitude of computers through the establishment of the World Wide Web. Subsequently, the progression led to the mobile-internet phase, connecting mobile devices to the Internet, and then to the people-internet phase, characterized by connections facilitated through social networks. Ultimately, it has evolved into the Internet of Things, forming a world of interconnected objects (Lampropoulos *et al.*, 2019). The Internet of Things (IoT) is a network of interconnected devices, both mechanical and sophisticated, that are registered and assigned unique identifiers (UIDs). These devices have the ability to transfer data throughout an enterprise without requiring human-to-human or human-to-Personal Computer (PC) collaboration. Moreover, Internet of Things enables the connection of people and objects seamlessly, anytime and anywhere, utilizing path or network, and ideally, with any service available (Khan *et al.*, 2022; Nguyen, 2023;

Abubakari *et al.*, 2023; Top, 2024). Thus, the connection of two or more computers, mobile phones, people and digital devices made possible by Internet of Things. The Internet of Things is progressing fast and changing how we live every day. These technologies can quickly and independently gather, handle, and share huge amounts of data, which can be used by services like banking, insurance, and transportation (Wangenheim, 2014; Nguyen, 2023; Sasu, 2023).

These Connected objects offer several benefits to the financial industry, and the banking sector in Ghana is investing significantly in new technologies to improve customer experience and consolidate their relationship (Alonge *et al.*, 2021). The telecommunication industry has also taken over a substantial aspect of the financial industry with its popular Mobile Money adventure (Donovan, 2012). Therein, the underlining objective of digital technology is to personalize the customer experience, making it possible for products and services to be provided on time with the right packaging, at the right place and via the right channel (Graphic Online, 2023; Oumaima & Lamari, 2024; Parise *et al.*, 2016). As of 2022, nearly half of Ghana's population had an account at a financial institution, which provides account holders with access to products and services such as online banking and debit or credit card ownership (Sasu, 2023; Khanboubi *et al.*, 2019). Thus, many people in Ghana hold personal bank accounts, which include students and drivers that would make their billing easy with AI and IoT technologies application.

According to Nguyen (2023), Digital economy is the use of technological tools and devices to create goods and service to make it accessible to consumers and market processes easy. The intent of digital economy is to convert physical goods and services into electronic goods and services and a direct example is the mobile banking system (Ampaw *et al.*, 2022), that currently runs the Ghanaian economy. The key components of the digital economy depends on the Internet of Things (IoT), which connects individuals, organizations and customers in their respective field of business cycle of the economy. Gordon, (1990) relates the growth of economy based on smart interactive system, which is quick to responses to economic activities. In this authors' paper, he creates an avenue to explain how human to human can interact, and collaborate in the economic cycle to provides services to each other. Given instances in the health sector, where patients and doctors can connect digitally or electronically to share vital medical information without physical contacts. Edquist *et al.* (2021) reechoed the significant roles of digital technologies by emphasizing that today's economies cannot be efficiently managed without the use of IoT.

The understanding of the opportunities and difficulties presented by IoT in the finance industry and other industries that operate in close proximity to it, is crucial for managers in these fields. Despite the hoopla surrounding IoT applications, a few industries have managed to

recognize its true potential. Experts and technology providers predict that by the end of this decade, the economic value of IoT applications will have increased to between \$300 billion and \$15 trillion (Accenture, 2021). According to Khanboubi *et al.*, (2019), IoT has fundamentally altered nearly every facet of the economy. IoT, which is predicated on the idea that physical objects can use the internet to connect data about their position, state, or other characteristics, is predicted to grow rapidly and play a major role in enabling Financial Service Institutions (FSIs) to take an active role in this transformation (Gartner, 2023; McKinsey & Company, 2022). Therefore, it ought to be simple for FSI managers to anticipate the potential advantages that come with possessing more thorough, up-to-date information on their own or their clients' financial holdings. IoT applications are found in a number of sectors, including telematics, building management systems, auto insurance, and "smart" commercial real estate. This feature makes it possible for banks and other financial institution to tract and monitor real estate of clients especially when used as collateral for loans (Porter & Heppelmann, 2015; McKinsey & Company, 2022).

According to (Olofin, 2023; Khanboubi *et al.*, 2019), digital economy in developing countries is based on institutional and digital quality. These papers examined the role of ICT device and the nature of selected developing Economies with respect to IoTs and other electronic devices. The result indicate that a successful digital economy must have a good human capital, knowledgeable workers on the digital system, true accountability by the government and other agency that will partner this agenda but state that corruption is major challenge can distract digital economic agenda. They put emphasis on the institutional quality to play fair role in accepting this new agenda of digital market.

The internet's widespread availability of data and processing capacity has grown the application of ICT domain. However, ICT was developed primarily with human-to-human communication in mind, and it was meant to be accessible through a computer. These two aspects of its original conception limit it. IoT adoption can have beneficial MFP benefits by facilitating access to ICT for the general public and industries, even in poor nations where there isn't a noticeable ICT saturation effect (Ganai *et al.*, 2024). The framework of growth accounted by Griliches (1969), is one of the bedrock of appreciating the impact of IoT. According to Schulte & Liu (2018), Financial Technology(FinTech) is moving into the field of Internet of Things and will transformed into quantum computing within a shortest period of time.

In the other hand, AI generates a high quality of data or result that can be analyzed in the form or conducted sentiment analysis into to determine how stakeholders perceive their transactions. Technology-savvy users, particularly early adopters, utilize their smartphones not only for communication but also for shopping and banking transactions. In developed countries, physical

bank payments or traditional financial transactions have shifted to mobile platforms, with smartphones serving as the primary tools for mobile payments (MoMo-Payments). Notably, this payment method eliminates the physical aspect of payments involving human beings as the collectors by relying on digitally connected methods". QR code mobile payment (m-payment) is a convenient and secure payment method that involves using a mobile device near a compatible terminal, such as at a workplace or in restaurants, cafes, and bars. This method has gained popularity due to its user-friendly approach, seamless data exchange, and integration with various features. Notably, it leverages Near-Field Communication (NFC) technology, which offers limitless possibilities (Catalunya, 2019). Cook & Rani (2023), also discusses the introduction of digital financing and economy, which transform the area of the financial sector of every country. They highlighted the need to accept the financial digital policies as it needs government's policies and infrastructure development of a country to establish resilient system, free from electronic system challenges. Mhlanga (2020), investigated the effects of AI on digital finance. According to him Fintech organizations, apply AI to make sure that their organizational objectives are met. The study was based on conceptual and documentary analysis reports and journals on AI and financial inclusion. Lau & Leimer (2018), tries to find out the trend of future of financial delivery services on the new dimension of AI. This paper provides the background of information concerning the modern technology and how it uses personal data and it clarifies the need to consider the benefits of society and financial institutions. Lazović (2014), adds that, "Information technology has influenced the financial sector activities to the extent that today's economy is total difference from yesterday.

Financial management plays a pivotal role in the success of organizations. It encompasses strategic planning, direction, and control of financial activities. Industry 4.0 technologies significantly impact financial management (Bisht *et al.*, 2022; Cheryl & Ng, 2022). According to BaFin (2018); Cheryl & Ng, (2022), Digital networking is taken in our modern dispensation to handle and control complex task within the financial sector. This suits the period of big data and provides the opportunity to use AI in financial sector. The report use BDAI applications to facilitate these innovations create room for analytical and mass data availability in the financial market. Singh, (2018) compared industrialization with Digitization of the financial sector of the Indian economy. The study indicates that the attention of industrialization is based on high powerful machine capable of using physical infrastructure to increase the production of goods and services, and this was effective and resilient than pass generation. The study argues that digitization is based on reframing the activities and organization structure into digital intelligence with the modifications of the organizational data. It mentioned that digital economy should clearly define from IT and software industries.

Semyachkov(2019), conducted a study into the purpose and role governing the building of digital financial sector or economy in developing countries. Much interest was put on the intellectual assets, increasing in digital data, network providers and network companies. In the digital economy the use of digital system must be formulated to suit the long term and short-term agenda of every country. As this system cannot do without challenge, the paper provides tools such as share economy, cloud computing as well as large database.

Given the safer, easier, and faster acceptance of QR code mobile-payment services compared to other mobile payment options, they are now widely embraced, particularly in tech-savvy societies (Qi *et al.*, 2023; Bukht & Heeks 2018). QR codes have surpassed classical barcodes in popularity across various domains due to several advantages. These include increased capacity, reduced physical size, and enhanced versatility. Notably, QR codes can represent the same amount of data in approximately one-tenth of the space required by traditional barcodes. They can encode information such as URLs, SMS messages, contact details, and plain text within their two-dimensional matrix (Quadri *et al.*,2014). Soldatos (2022), also conducted a research on both IoT and AI in the financial sectors and revealed that Banks and financial institution are celebrating their gains in the field of digital transformation. Banks and financial organization produce enormous data or big data in every single day. The study illustrates how banks and financial organization uses Internet of Things and Artificial intelligence for data collection, processing and data analysis and this help them ascertained their gains and loss. The introduction of digital economy transforms how people carried their economic activities irrespective of their location.

According to Voulgaridis *et al.* (2022), the environment to which IoT applicable is wider in the economic spectrum which is based on the interconnection of physical and digital devices which must have the capability to read the QR code with the IoT sensors. This kind of technology can be implemented, as a global monitoring device and most economics issue are interrelated. According to Cheryl & Ng (2022), customers and consumers data on IoT network connection must be protected at all cost to safe guide the valuable information that runs on this medium to promotes the digital economy. The paper spelt out the challenges and gaps that needs to be address before this system can be implemented by governments and other regulatory bodies in the country. The paper point situations where data breach and cyber issues can crop in to the digital economy system. Automation is predicted to have revolutionized the financial services that the individual receives as it is quickly replacing the human efforts in important financial tasks like stock trading, risk assessment and also extending credit to those that want to obtain loans (Polireddi, 2024). Moreover, Panneer (2025), reveals that machine learning and natural language processing have enhanced operational efficiency, improve

decision making processes, and revolutionize customer experiences in financial institutions.

In Muhammad (2024), a cross-sectional, survey-based method was used in this study to examine Artificial intelligence, financial services knowledge, government support, and user innovativeness. The findings of this study indicates that the integration of AI in finance impacts positively on financial technology (Fintech). It also revealed that perceived ease of use moderates the relationship between government support and user innovativeness. The integration of AI into the financial sector is considered pivotal for developing robust fraud prevention algorithms, which analyze vast data volumes to identify malicious activities and prevent financial losses (Garcia-Segura, 2024). It is found that the development of AI can alleviate the financing challenges of non-SOE firms and it is more effective when it has to do with small firms (Shao, 2021).

MATERIALS AND METHODS

This paper leverages on the available literature, Google forms questionnaires administered through purposive sampling with a sample of 688 Students and 786 drivers as the main respondents. Aside from using charts to represent the data retrieved from these respondents for better understanding, analysis was also done in segments according to the defined objectives of this study. Thus, the segment targeting students and the university system, and the segment targeting drivers and the road tolling system in Ghana as well as segment that target general mobile money users and their challenges. Shown in Figure 1 is the regional distribution of respondents engaged in this study.

Regional Distribution of responses

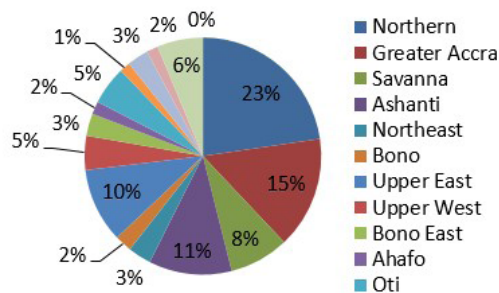


Figure 1: Regional Distribution of participants' responses

Data on Mobile Money

As the intended solutions for the two main segments considered in this study partly hinges on Mobile Money usability and application, we present a general statistics and outlook of this main financial flow medium as shown in Table 1. The nation's mobile money user base is progressively growing. There were 65.6 million registered mobile money accounts as of the end of 2024. Similarly, there were 22.8 million active mobile money accounts at the end of the fourth quarter of 2024. At the end of

2024, there were 817,000 registered agents and 609,000 active agents (those who had transacted at overcast once in the 30 days before reporting). 65.5 billion Ghana Cedis

(GHS), (approximately 32.7%) more mobile money transactions were made in 2024 than in 2023.

Table 1 summarized the mobile money data from the

Table 1: Mobile Money Data

	2019	2020	2021	2022	2023	2024
Mobile Money Date						
Registered Mobile Money account (Million)	32.5	38.5	48.3	55.3	56.7	65.6
Active Mobile Money Account (Million)	14.5	17.1	17.9	20.4	20.5	22.8
Registered Agents (Thousand)	306	424	580	700	729	817
Active Agents (Thousand)	226	328	442	505	508	609
Total Number of Transactions (Million)	200	301	401	488	493	657
Total value of Transactions (Billion-GHC)	32.8	67.7	82.9	122	134.0	199.3
Balance on float (Billion-GHC)	3.6	7.0	9.7	13.1	12.7	18.3

Source: BOG

bank of Ghana which indicates that Ghana recorded over 65.6 million registered mobile accounts with about 22.8 million active accounts. The report from Bank of Ghana further shows that, a total value of MoMo transactions stood at 3.01 trillion Ghana cedis in 2024 representing 56.8% increase compared to 1.9 trillion Ghana cedis in 2023 (BoG, 2025). This is to suggest that many customers are enrolled on to the mobile money platform which can facilitate the implementation of digital payments such as school fees and automatic billing for road tolls at the tollbooths which can be powered by the above modern technologies.

RESULTS AND DISCUSSION

Students Fee Payments System

It is unbelievable but true that, in this current automated technological dispensation, students among other players in the financial industry has to still rely on the traditional banking approach for fee payments. This triggered the researchers' interest in ascertaining available platforms for university and colleges fee payments and propose possible recommendations to improve the system of payment. Figure 2 depicts the graphical representation of the summary of responses on the medium of payment focusing on students' fee payment.

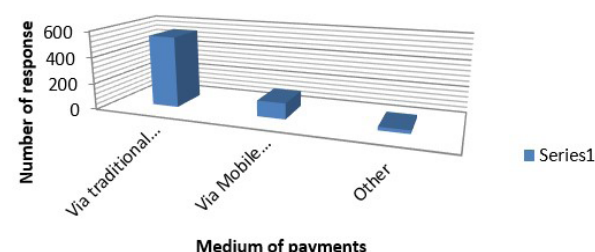


Figure 2: Variance on payment mediums

From Figure 2, 542 of the respondents engaged still pay their school fee by queuing in the banking halls while 120 respondents pay via digital platforms especially MoMo. This includes academic user and other subsidiary fees paid at the school or departmental levels.

Age Distribution

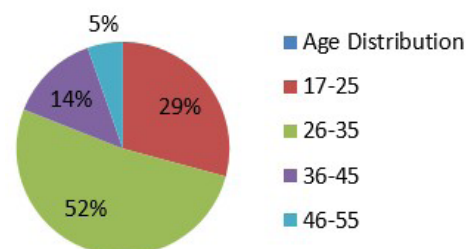


Figure 3: Age Distribution of Respondents

Figure 3 represents the age distribution of the respondents. The ages between 26 to 35 years carries the majority with about 52%, while 17 to 25, 36 to 45 and 46 to 55 years garnered 29%, 14% and 5% respondents respectively. This simply means that over 66% percent of mid working class responded to the survey.

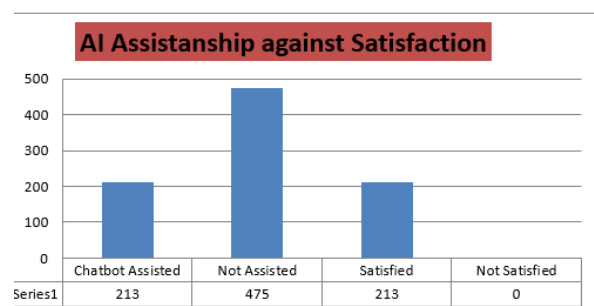


Figure 4: Summary of Manual and AI Assisted works against Satisfaction

In Figure 4, we represent a bar chart of those who have experienced the Artificial Intelligence (AI) assistantship like Chat GPT in one way or the other. The survey shows that over 213 people have ever used AI and got the required satisfaction. However, about 475 people who responded to the survey have never gotten assistance from an AI agent. This implies that the survey did not record any response showing dissatisfaction in AI agent.

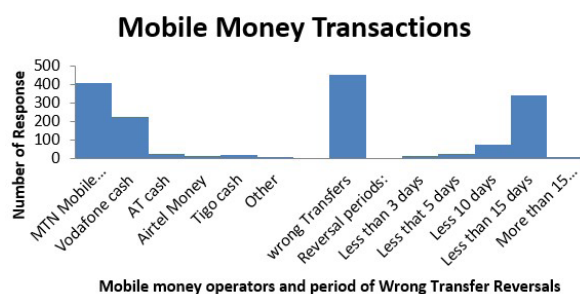


Figure 5: Data on Wrong E-Cash Transfer and duration of reversal by respond

Figure 5 is a graphical representation of mobile money transaction in relation to this survey. This research captured MTN Ghana (MTN MoMo), Vodafone / Telecel Ghana (Vodafone cash), Tigo cash, and Airtel Money as well as their merger, AT Ghana (Airtel Tigo Cash) as mobile network operators who works in the mobile money services. MTN Ghana with its MoMo had the highest customer base or respondents according to the survey with over 406 respondents, followed by Vodafone Ghana with its Vodafone Cash garnering over 226 respondents whereby the merger of AirtelTigo had 54 responses but 4 people opted for other mobile money services like ZeeMoney. Out of the 688 respondents received, 450 of them established they had experience wrong transfers.

The survey further tried to ascertain the time period it takes for a reversal to be done on monies transferred to wrong account. Majority of the people summing up to 342 suggest that, it took them between 10 to 15 days to get

back their monies. About 71 people had gotten back their monies within 10 days and about 34 people got back their money in less than 5 days. This seems to suggest that one is unable to reverse his/her money instantly when wrong transaction occurred. Wrong transaction often occurred during transfer of electronic cash/money (e-cash) where the 10 digits code known as the mobile money number is keyed in wrongly. This occasioned monies to be sent to a wrong person or account. This phenomenon can be resolved by adopting QR code payment system as being suggested by this paper. QR code is a machine generated invisible security code that is assigned to a device, a link, resource or an account details. The sending account or device scanned the recipient account or device to get connection of the two for transactional purposes. This would ensure accuracy and security in the financial digitization processes when adopted and implemented fully.

Drivers and Road Toll Payments

On the other hand, Figure 6 represents a summary of response collated from drivers who have experience in road tolls payments. Over 786 drivers responded to the survey subscribing to the above listed challenges that allegedly lead to the scrubbing of the road tolls. Out of the total number of drivers who responded, 412 said it was waste of time and creating huge traffic jumps at the tolls while 153 said revenue mobilize from the road tolls were misused and 167 asserted that there was corruption in the collection of the road tolls but 54 people out of the number stated other reasons why they were happy about the suspension of the road toll.

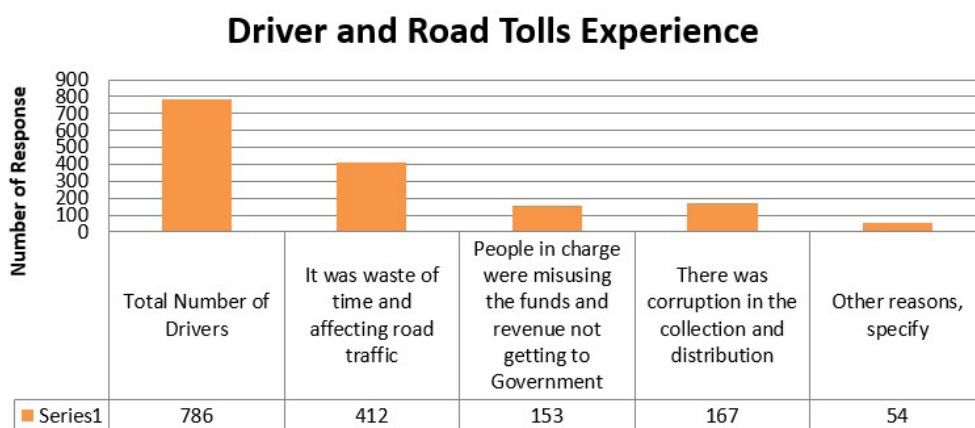


Figure 6: DDrivers and Road Tolls Experience

As shown in Table 6, the fee charged on Road tolls is not a big problem to the drivers and car owners however, the actual problem had to do with time spent during toll payments, heavy traffic at the tollbooth and corruption. Consequently, a digital system powered by an IoT technology to collect road tolls and give time notification to oversight agencies responsible for controlling roles is proposed. Figure 7 outlines the framework of the proposed system for the collection and reporting of road

tolls to the central government and other stakeholders such as Roads and Highway Authority. Shown in Figure 7 is the operational flow representation of the automatic billing system known as the framework. It is proposed that, every vehicle's number plate be embedded with QR code and every tolling point should be embedded with QR code reader and automated billing system. When a vehicle approaches a tolling point or tollbooth, its QR code would be read and communicated

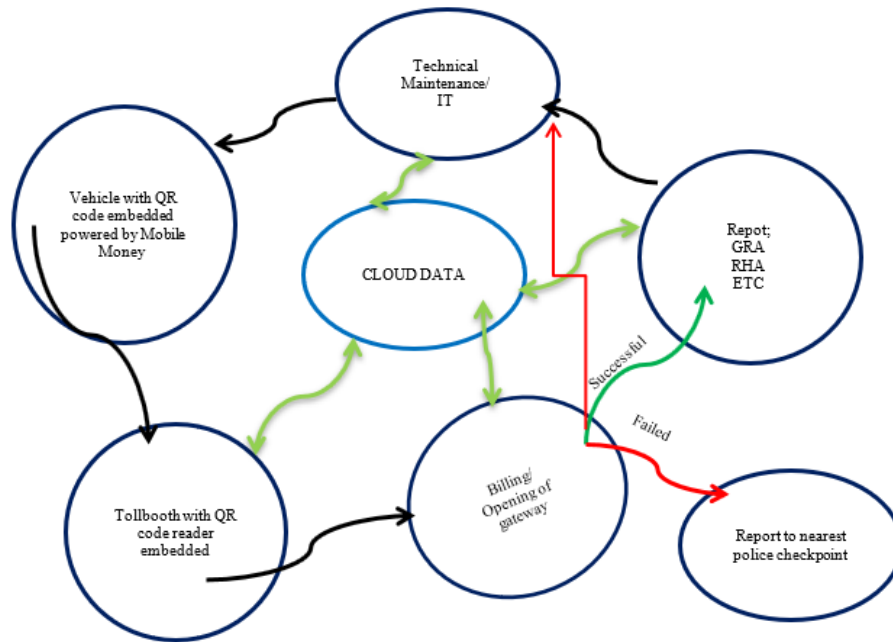


Figure 7: Operational flow of the Automatic Toll Billing System

with the system for automatic billing. Vehicles are billed in accordance with their weight and engine capacity. Here, we proposed two ways to obtain the actual bill for deduction by pre-coding the weight or the appropriate bill of every vehicle and or embed a scale at every tollbooth for weight of vehicles to be recorded and transfer to the system for appropriate billing. After QR code is read, the appropriate deduction is done on the customer's/ vehicle's account. The system reports to the technical team as well as the nearest police check point considering the direction of the vehicle. The proposed system allows users to load or top up their accounts balance using mobile money transaction or credit top-up. Moreover, the system reports in real-time, any technical issue including failed billing to the technical team for quick resolution. After a successful billing, the system submits a summary report to the Ghana Revenue Authority (GRA), Ghana Roads and Highway Authority (GRHA), Monitoring and evaluation team as well as any other stakeholder who matters. The entire transactional information is stored in the cloud and can be sourced anytime for accounting purposes. The proposed system loops after every successful billing and also allows multiple billing.

Discussion

This paper leverages on AI and IoT technologies in building robust payment systems in Ghana, focusing on driver's road tolls and student's college/university fees payments as they stimulate economic growth while guaranteeing convenience and accountability. The study proposes efficient payments processing through AI with effective connectivity through IoT to ensure robust tolling systems in Ghana to fuel economic growth through digitalized-enabled revenue mobilization.

The data analyzed as presented in section 4, revealed that almost all public tertiary institutions (Universities and colleges) in Ghana rely on the traditional banking system for fee collection. The survey further attempted to access students' frustrations during school fee payment periods and to seek acceptance of an automated payment systems whereby students can make payment of school fees at the comfort of their dormitories/hostels. Thus, making payment easier, and accessible at any time regardless of location. This is made possible by machines ability to make payment decisions (AI) without or little efforts from humans. It is even simpler when objects are connected globally (IoT) with QR codes imbedded in them, reduces errors and wrong payments.

In comparing to de Luna *et al.*, (2019), this study highlights the means through which students pay their schools fees and other banking transaction whiles comparing three factors that determines the use of Technology such as short message system (SMS), near field communication(NFC) and quick response (QR). In addition, this study discusses the role of AI and IoT's in the financial and banking ecosystem and how they reduces the pressure on traffic and road toll collectors whiles de Luna *et al.*, (2019) focus on the payment response system with Technology Acceptance System (TAM) and by explaining consumer's behaviors. Khanboubi *et al.*, (2019) also shares the same view with this study. They posit that IoT's and AI are the next digital revolution that would transform the lives of individual as this paper explains how students and road users can use this technology to make live simple by implementation to build a robust financial system for stress-free revenue mobilization to support economic development.

CONCLUSION

This paper shows the willingness to the adoptability of digital payment environment. When the proposed framework is finally adopted, financial transactions would be more secured, convenient and quicker as it presents the solutions to wrong electronic money transfers by the use of QR code supported system as well as its effort to reduce time spent or queues in the traditional banking halls. Aside making it possible for parents or students to pay their schools fees at the comfort of their homes and offices, it would also provide an automated payment system at the tolling points to collect road tolls. This is made possible where every vehicle would have an account connected with owners mobile money account for easy loading. Appropriate bills are deducted from the vehicle account anytime it approaches a tollbooth without necessarily stopping. In light of this, the unnecessary road traffic jumps are prevented. Generally, all mobile money account holders should be sensitized on how to make payment via QR code supported software. This would make wrong transfer a thing of the past.

our analysis shows drivers' readiness to support government in revenue generation for good roads infrastructure through efficient and digitized payment systems. Hence, it is recommended that, policy makers and for that matter Government of Ghana should develop interest in implementing this framework to maximize revenue mobilization at the tollbooths. Also, Colleges and Universities authorities, banks and policy makers should implement the above framework by adopting digital payments of school fees to relief students and banking staff from unnecessary stress in this digital age.

REFERENCE

- Abubakari, A. R., Agbedemrab, P. A., & Azaare, J. (2023). An automated fire detection and reporting system based on AI and IoT technologies. *International Journal of Scientific Research and Engineering Trends*, 9(5), 1411-1416. <https://doi.org/10.61137/ijstret.vol.9.issue5.102>
- Ahinsah-Wobil, I. (2022). Ghana's Road Toll and E-Levy: The consideration for a Good IMF Deal. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4171809>
- Akhtar, M., Salman, A., Ghafoor, K. A., & Kamran, M. (2024). Artificial intelligence, financial services knowledge, government support, and user innovativeness: Exploring the moderated-mediated path to fintech adoption. *Helixyon*, 10(21).
- Alonge, E. O., Eyo-Udo, N. L., Chibunna, B., Ubanadu, A. I. D., Balogun, E. D., & Ogunsola, K. O. (2021). Digital transformation in retail banking to enhance customer experience and profitability. *Iconic Research and Engineering Journals*, 4(9).
- Ampaw, E.M., Nte-Adik, N.M., Azaare, J., Adu-Sackey, A., Essah, B.O., Amuzu, G. (2022). Embracing mobile financial inclusion in the wake of COVID-19 pandemic: The mediating role of cognitive and affective-based trust embeddedness. *Int. J. Technol. Manag. Res.* 2022, 7, 1–22
- BaFin. (2018). *Big Data Meets Artificial Intelligence: Challenges and Implications for the Supervision and Regulation of Financial services*. https://www.bafin.de/SharedDocs/Downloads/EN/dl_bdai_studie_en.html
- Bank of Ghana. (2025). *Payment Systems Oversight Annual Report 2024*. Bank of Ghana.
- Bisht, D., Singh, R., Gehlot, A., Akram, S. V., Singh, A., Montero, E. C., Priyadarshi, N., & Twala, B. (2022). Imperative Role of Integrating Digitalization in the Firms Finance: A Technological Perspective. *Electronics (Switzerland)*, 11(19). <https://doi.org/10.3390/electronics11193252>
- Bukht, R., & Heeks, R. (2018). *Digital Economy Policy in Developing Countries*. <https://doi.org/10.13140/RG.2.2.24272.15364>
- Mobile payment is not all the same: The adoption of mobile payment systems depending on the technology applied. (2019). *Technological Forecasting and Social Change*, 146, 931–944. <https://doi.org/10.1016/j.techfore.2018.09.018>
- Cheryl, B. K., & Ng, B. K. (2022). Protecting the Unprotected Consumer Data in Internet of Things: Current Scenario of Data Governance in Malaysia. *Sustainability (Switzerland)*, 14(16). <https://doi.org/10.3390/su14169893>
- Cook, S., & Rani, U. (2023). *Platform work in developing economies: Can digitalisation drive structural transformation?* (SCIS Working Paper No. 63). Southern Centre for Inequality Studies, University of the Witwatersrand. <https://www.wits.ac.za/scis/research-projects/digital-technologies-the-future-of-workers-and-inequality/>
- De Luna, I. R., Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. (2019). Mobile payment is not all the same: The adoption of mobile payment systems depending on the technology applied. *Technological Forecasting and Social Change*, 146, 931–944. <https://doi.org/10.1016/j.techfore.2018.09.018>
- Edquist, S. (2021). *Ecological interactions of the trematode parasite Zoogonus rubellus and its first and second intermediate hosts* [Master's thesis, University of New Hampshire].
- Ganai, K. A., Pandow, B. A., & Masoodi, F. S. (2024). IoT-enabled financial inclusion: Challenges, opportunities, and policy implications. In *Internet of Things applications and technology* (pp. 126–145).
- García, M. (2016). The impact of IoT on economic growth: A multifactor productivity approach. In *Proceedings of the 2015 International Conference on Computational Science and Computational Intelligence (CSCI 2015)* (pp. 855–856). IEEE. <https://doi.org/10.1109/CSCI.2015.134>
- Garcia-Segura, L. A. (2024). The role of artificial intelligence in preventing corporate crime. *Journal of Economic Criminology*, 5, Article 100091.
- Gartner. (2023). *Top strategic technology trends*. Gartner Research.

- Gordon, N. M. (1990). Report of the Committee on the Status of Women in the Economics Profession. *The American Economic Review*, 80(2), 486–489. <http://www.jstor.org/stable/2006629>
- Graphic Online. (2023). *The Ghana banking industry report 2023: An annual performance review*. Graphic Online.
- Griliches, Z. (1969). Errata: The Explanation of Productivity Change. *The Review of Economic Studies*, 36(3). <https://doi.org/10.2307/2296436>
- GSMA. (2018). *The mobile economy 2018*. GSMA Intelligence. <https://shorturl.at/16N5R>
- Khan, F., Xu, Z., Sun, J., Khan, F. M., Ahmed, A., & Zhao, Y. (2022). Recent advances in sensors for fire detection. *Sensors*, 22(9), Article 3310. <https://doi.org/10.3390/s22093310>
- Khanboubi, F., Boulmakoul, A., & Tabaa, M. (2019). Impact of digital trends using IoT on banking processes. *Procedia Computer Science*, 151, 77–84. <https://doi.org/10.1016/j.procs.2019.04.014>
- Lampropoulos, L., Hicks, M., & Pierce, B. C. (2019). Coverage guided, property based testing. *Proceedings of the ACM on Programming Languages*, 3(OOPSLA), 1–29.
- Landes, D. S. (1990). Why are we so rich and they so poor? *The American Economic Review*, 80(2), 1–13. <http://www.jstor.org/stable/2006534>
- Lau, T., & Leimer, B. (2018). The era of connectedness: How AI will help deliver the future of banking. *Journal of Digital Banking*, 3(3), 215–231.
- Lazović, V. (2014). Prospects of developing countries in digital economy: Case study of Montenegro.
- Mhlanga, D. (2020). Industry 4.0 in finance: the impact of artificial intelligence (ai) on digital financial inclusion. *International Journal of Financial Studies*, 8(3), 1–14. <https://doi.org/10.3390/ijfs8030045>
- McKinsey & Company. (2022). *The value of IoT in financial services*. McKinsey Global.
- Naaz, S., Parveen, S., & Ahmed, J. (2021, March). An artificial intelligence based toll collection system. In *Proc. 2nd Int. Conf. ICT Digit., Smart, Sustain. Develop. (ICIDSSD)*, February, Jamia Hamdard, New Delhi, India
- Nguyen, O. (2023). *Digital Economy and Its Components: A Brief Overview and Recommendations*.
- Olofin, O. P. (2023). Digital Economy, Institutional Quality and Economic Growth in Selected Countries. *CBN Journal of Applied Statistics*, 14(1), 25–46. <https://doi.org/10.33429/Cjas.14123.2/5>
- Oumaima, J., & Lamari, S. (2024). Customer Experience in the Digital Transformation Era: Insights on Personalization, Digital Marketing, and Customer Relationship Management. *International Journal of Economics, Management and Finance (IJEMF)*, 3(2), 52–69.
- Parise, S., Guinan, P. J., & Kafka, R. (2016). Solving the crisis of immediacy: How digital technology can transform the customer experience. *Business horizons*, 59(4), 411–420.
- Payne, E. H. M., & O'Brien, C. A. (2024). The search for AI value: The role of complexity in human-AI engagement in the financial industry. *Computers in Human Behavior: Artificial Humans*, 2(1), 100050.
- Porter, M. E., & Heppelmann, J. E. (2015). How smart, connected products are transforming companies. *Harvard Business Review*, 93(10), 96–114.
- Quadri, C., Zignani, M., Capra, L., Gaito, S., & Rossi, G. P. (2014). Multidimensional human dynamics in mobile phone communications. *PloS one*, 9(7), e103183.
- Qi, Y., Sun, Y., Zhang, Z., Shi, Y., & Liu, L. (2023). The digital economy—Technologies, trends, and influences. *Personal and Ubiquitous Computing*, 27(4), 1521–1523. <https://doi.org/10.1007/s00779-023-01734-z>
- Sasu, D. D. (2023). *Banking industry in Ghana—Statistics & facts*. Statista. <https://www.statista.com/topics/10469/banking-industry-in-ghana/#topicOverview>
- Schulte, P., & Liu, G. (2018). Fintech is merging with IoT and AI to challenge banks: How entrenched interests can prepare. *Journal of Alternative Investments*, 20(3), 41–57. <https://doi.org/10.3905/jai.2018.20.3.041>
- Semyachkov, K. A. (2019). *Digital economy in developing countries: Problems and prospects*.
- Soldatos, J. (n.d.). *Big data and artificial intelligence in digital finance*.
- Siddiqui, M. K., & Goyal, K. K. (2023). A study of the use of e-payment systems based on artificial intelligence. In *Artificial Intelligence and Communication Technologies* (pp. 1063–1076). Soft Computing Research Society.
- Singh, P. J. (2018). *Digital industrialisation in developing countries*. Commonwealth Secretariat.
- Singh, N., Jain, N., & Jain, S. (2025). AI and IoT in digital payments: Enhancing security and efficiency with smart devices and intelligent fraud detection. *International Research Journal of Modernization in Engineering Technology and Science*, 6(12), 982–991.
- Solow, R. (1987). We'd better watch out. *New York Times Book Review*, 1987. <http://ci.ni.ac.jp/naid/10007455402/>
- Sutjarittham, T., Gharakheili, H. H., Kanhere, S. S., & Sivaraman, V. (2019). Experiences with IoT and AI in a smart campus for optimizing classroom usage. *IEEE Internet of Things Journal*, 6(5), 7595–7607.
- Talpur, C., Kalwar, F., Akbar, T., Bhacho, I. A., Soomro, N. Q., & Memon, M. (2025). Automatic Detection of Toll Tax-exempted Vehicles Using Machine Learning Techniques. *Journal of Computing & Biomedical Informatics*, 9(01).
- TBop, B. (2024). Banking on AI from the age of AI. In *The “new” digital economy and development: UNCTAD technical notes on ICT for development (No. 8)*. United Nations Conference on Trade and Development (UNCTAD).
- Viswanathan, P. S. (2025). Artificial intelligence in financial services: A comprehensive analysis of transformative technologies and their impact on modern banking. *International Journal of Research in Computer Applications and Information Technology (IJRC.AIT)*, 8(1).

- Voulgaridis, K., Lagkas, T., Angelopoulos, C. M., & Nikolettseas, S. E. (2022). IoT and digital circular economy: Principles, applications, and challenges. In *Computer Networks* (Vol. 219). Elsevier B.V. <https://doi.org/10.1016/j.comnet.2022.10945>
- Wangenheim, F. (2014). *High Tech and High Touch*. January. <https://doi.org/10.1177/1094670512448413>
- Yalli, J. S., Hasan, M. H., & Badawi, A. A. (2024). Internet of Things (IoT): origins, embedded technologies, smart applications, and its growth in the last decade. *IEEE access*, 12, 91357-91382.
- Zakaria, S., Manaf, S. M. A., Amron, M. T., & Suffian, M. T. M. (2023). Has the world of finance changed? A review of the influence of artificial intelligence on financial management studies. *Information Management and Business Review*, 15(4), 420-432.