Effects of Using Internet of Things (I.o.T) Systems in Transportation on Customer Service Delivery

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Abstract:- The growing of Internet of Things (IoT) introduces new ways of delivering transportation services. By moving product from locations wherever they are demanded to its suppliers and customers. The transportation corporations use IoT hardware devices and software package applications to deliver services to customers, and these devices are equipped with sensors, which create an interaction between the application layers and service layer of the vehicle. The cards must be sensed by the sensors which are embedded within the electronic devices called POS machine and transferred to service layer through a proper communication, and card's information are processed for payment. The main problem during this study was the lack of real time information from facts on the financial management of the daily transportations on the side of transport companies and easy of services delivery on the side of customers. The main objective of this study was to discuss the effects that IoT might have on transport in Kigali City, mentioning its implications, challenges and technical solutions. The specific objectives were: to study technologies currently used for transport in Kigali City, to investigate the challenges faced by transportation for customer service delivery in Kigali City, to conduct the analysis of Internet of Things skills, and finally to evaluate the effects of IoT technology for transport in Kigali City. Data were collected and analyzed using Machine Learning (ML) Models. The results indicated that 62.57% of respondents were male, 76.1% of respondents had bachelor level of education, 27.49% of respondents were KBS drivers, and 21.64% of respondents have between 6-10 of years of experience. The first objective of this study was to study technologies currently used for transport in Kigali City: the findings have shown that the system that was being used was made up with devices with application layer, sensing layer, communication layer, service layer, and infrastructure layer. The second objective of this study was to investigate the challenges faced by transportation for customer service delivery in Kigali City: the findings have shown the information to challenges of using IoT in transport. The third objective of this study was to conduct the skills: the findings have revealed 168 out of 171 respondents confirmed that may enhance financial security. The fourth objective of this study was to evaluate the effects of IoT technology for transport in Kigali City: the findings have summarized 162 out of 171 respondents said that having full information from a transport company may improve the quality of transport. Lastly, results have shown to which extent the information was given to the passengers employing this technology in transport at KBS transport company. Results summarized the information to passengers on the using IoT in transport. They also summarized the challenges in using IoT in transport, and has shown the effects of information in using IoT in transport.

Keywords:- Internet of Things, IoT Systems, Transport, Service Delivery.

I. INTRODUCTION

Internet of Things (IoT) is the term used once devices or objects area unit embedded with the power to speak through the net. In IoT, two devices are equipped with sensors, actuators, processors and hardware for wireless affiliation. Sensors are used to collect information from the encircling physical environment. (Sethi & Sarangi, 2017). Nowadays, IoT is grabbing a lot of attention, with the terminologies like smart homes and smart cities. Everyday appliances like coffee makers, refrigerators and TVs are already equipped with the capability of connecting to the internet (Yung-yu, 2020). All these devices can communicate wirelessly and send or share their data.

While sensors are used to sight any changes within the physical surroundings, actuators are used to move with the surroundings, like the information from the temperature sensing element is used to mechanically management the thermostat (Rashid, 2016). The sizes of IoT devices are little, and due to their size and power they need restricted computing capabilities (Sethi & Sarangi 2017). The information collected from the sensors are, if doable, processed at intervals the sensing element or sent to a close-by device, or to a remote server for process and storage. All IoT devices are equipped with the hardware that allows them to attach wirelessly. The sort of communication that happens in IoT is mainly thirty machine to machine (M2M). There's very little human interaction, for instance, when installing the devices, giving directions or accessing the information (Alaba et al., 2017).

II.   LITERATURE REVIEW

According to Joseph (2018), public transportation - also known as public transportation, public transit, mass transit, or simply transit - is a system of public transportation for passengers that is managed on a schedule, operates on established routes, and charges a posted fee for each trip. In Rwanda, licensed public bus and minibus companies and cooperatives, motorbike cooperatives, vehicle rental firms, and taxi cab companies and cooperatives provide road transportation for people.

A. Public Transport in Rwanda

➢ *Express Buses*

They travel between large towns on a regular schedule (typically every 30 minutes), stopping only at designated points near the station. Even if you exit earlier, The fare to the next major stop must be paid.. Almost all routes in Kigali pass via Nyabugogo. Private companies operate the buses, which sell tickets in advance at a government-set fare.

➢ *Taxi Cab*

A taxi, often known as a taxicab or cab, is a form of private vehicle with a driver that is frequently used for non-shared transport by a single passenger or small number of people Taxicabs transport clients to their preferred destinations. This is in contrast to public transportation, where the service provider, rather than the consumers, selects the pick-up and drop-off locations.

➢ *Moto Taxi*

Moto-taxis make up a major fraction of the vehicles on Rwandan roadways, particularly in Kigali. A single person can board and disembark from the back of a motorcycle or scooter, pay the fee for the voyage.

B. Internet of Things (IoT)

➢ *General Overview*

The Internet of Things is a sophisticated technology that specialize in broader perspective in providing solutions to engineering issues. IoT is associate embodiment of each a pair of data and communication technologies connected to specific application. In IoT no matter is also the application, few sensing instruments that has each the nano and small sized electro-mechanical equipment's are present (Joseph, 2018).

➢ *Iot Architecture for Transportation*

IoT design for installation consists of 5 completely different layers. These layers include the applying layer, sensing layer, communication layer, service layer, and infrastructure layer (Ibrahim, 2020).
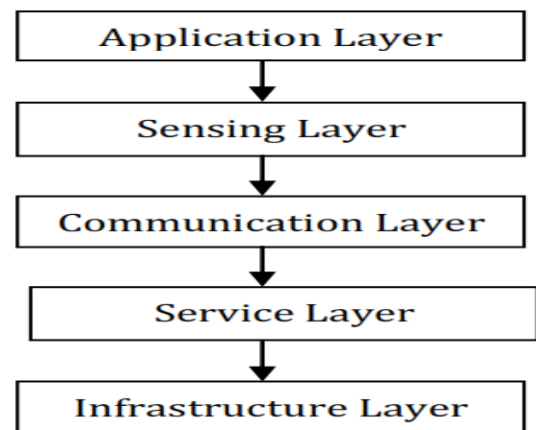

Fig 1. Iot Architecture for Transportation (Ibrahim, 2020)

- *Application Layer*

Within the case transportation, application layers involves the tasks associated with thirteen people, vehicles, roads, merchandise and different services and traffic.

- *Sensing Layer*

Sensing layer is that the one that has associate interaction between the applying layers to the vehicle captains by suggests that of electronic devices referred to as sensors network. Many of the electronic parts or gadgets got to be used, these includes: CCTV, Cameras, sensors, RFIDs, microwave technology, infrared technology, image or text readers.

- *Communication Layer*

This layers acts as information bridge between the sensor layers and the service layers. This layer helps in the data transmission from sensor layer to the service layer by means of 3G/4G/5G Network, Wi-Fi, Wired Network, Optical Fiber, Public and Private Network.

- *Service Layer*

Service layer gets the detailed information from sensor layer through the communication layers. The obtained information is processed in many ways and different analytics were performed various computing tools.

- *Infrastructure Layer*

Infrastructure layer is the one which creates the technology required for performing the various services. These includes the GIS mapping service, cloud computing platform, cloud storage, big data analytics tools etc. This layer mainly allows the improvements required for performing the reliable services.

C. Iot Solutions for Public Transport

➢ *E-Ticketing System*

Smart cards - also known as "Tap & Go" - are used by passengers to board buses. With POS machines, the system use NFC technology - Smart card tag and Card reader. Smart cards are available for purchase at the bus station store. Smart cards with a RWF 500 pre-loaded balance are marketed for RWF 1,000.

Fig 2. Tap & Go Smart Card (JICA, 2021).

The smart cards and the card reader are designed by AC Group. The system vendor, AC Group, receives a 5% commission on gross revenue collected per bus. AC Group collaborated with the Rwandan government and the bus company to develop the smart cards and card reader (Ibrahim, 2020).

➤ Smart Ticket Management System

RURA collects bus location information, in addition to the number of passengers and the amount of money received every bus and per bus ride, using the Smart Ticket Management System. The system has yet to be updated to reflect changes in bus routes. It is not possible to collect precise, relevant data that represents actual bus operations, because it just takes data from POS machines rather than the genuine ones from the bus, it may obtain the number of passengers and the amount collected per bus at bus terminals and bus stops, which is a problem.

III. METHODOLOGY

A. Research Design; Study Population; Sample Size; Data Collection Tools

➤ Research Design

Researcher consulted secondary data and experts publications on the subject being studied. Literature to consult was obtained from tangible and/or non-tangible media and Internet media in the form of journals, e-books and other materials relevant to cybercrime frameworks and model development to find out how to bridge the gap identified in current model.

➤ Study population

The target population was the KBS staffs and employees. In this context, the population of this study shall be KBS staffs and employees, KBS drivers, KBS Line Managers, KBS Monitoring Officers, Card Recharge Agents, and passengers. The total population is 300 individuals.

➤ Sample Size

The sample is done in from knowledge gained to represent the entire target under study (Cohen et al., 2011). Sampling is the action of selecting the quantity of observations to include in a statistical sample. The sample size of 171 respondents was drawn from the target population

➤ Tools for data collection

Data collection involves gathering of data using defined techniques in order to answer the pre-determined research question of the study. Researcher used questionnaire as an instrument consisting of questions for the purpose of gathering information from respondents. Researcher used questionnaire because the study concerned with variables that could not be observed such as views, opinions, perceptions, and feelings of the respondents.

IV. ANALYSIS AND FINDINGS

A. Software Environment

- *Python 3.10* - Python is a high level and effective general use programming language. It supports multi-paradigms. In this thesis, the following python libraries were used.
- *Pandas* - It is a python package that provides expressive data structures designed to work with both relational and labelled data. It is an open source python library that allows reading and writing data between data structures.
- *Numpy* - It is an open source python package for scientific computing. Numpy also adds fast array processing capacities to python.
- *Matplotlib* - It is an open source python package used for making plots and 2D representations. It integrates with python to give effective and interactive plots for visualization.
- *Sklearn* - It is an open source python machine-learning library designed to work alongside Numpy. It features various machine-learning algorithms for classification, clustering and regression.

B. Results of Model Testing by Python.

- Information to Passengers on the Use of Iot in Transport

Table 1. Dataset: Information to Passengers

	Information_to_passengers_IoT	Frequency
0	Tap&Go Card information	89
1	HardwareInformation	57
2	Software Information	71
3	Information/KBS Services	50
4	Vehicle tracking information	32
5	Notification by drivers	92
6	Bus destination notification	101
7	Card recharge information	136

Fig 3: Information to Passengers

> The dataset used was from the machine where they were stored. We first imported dataset with use of CSV library called "transport_iot.csv".
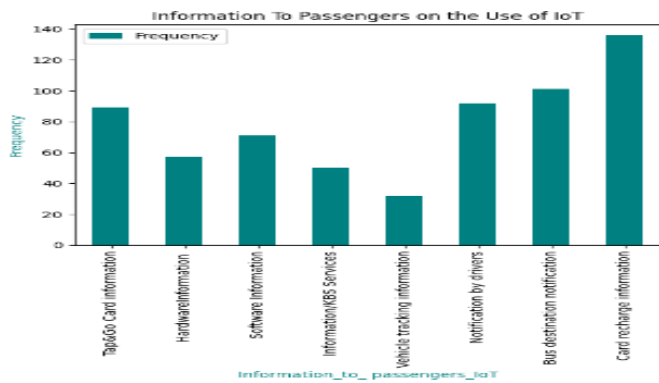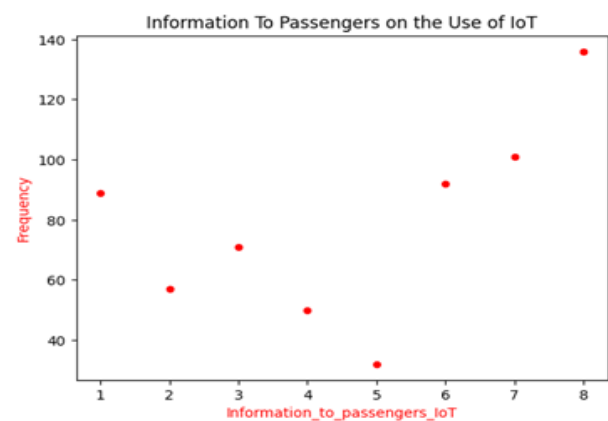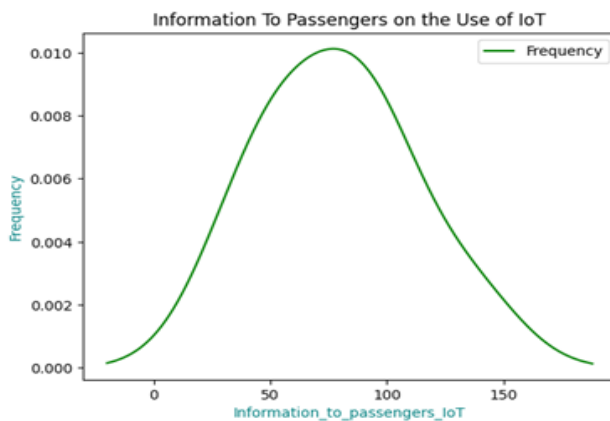

Fig 4. Information to Passengers About Iot an Transport

> Information in the Figure 4 shows different graphs generated using: a, b – linear regression, and b – lasso regressor. The graphs were represented with the same data retrieved from the same dataset so to have the data represented using different models.

- Challenges of Using Iot in Transport

Table 2. Dataset: Challenges _ Iot

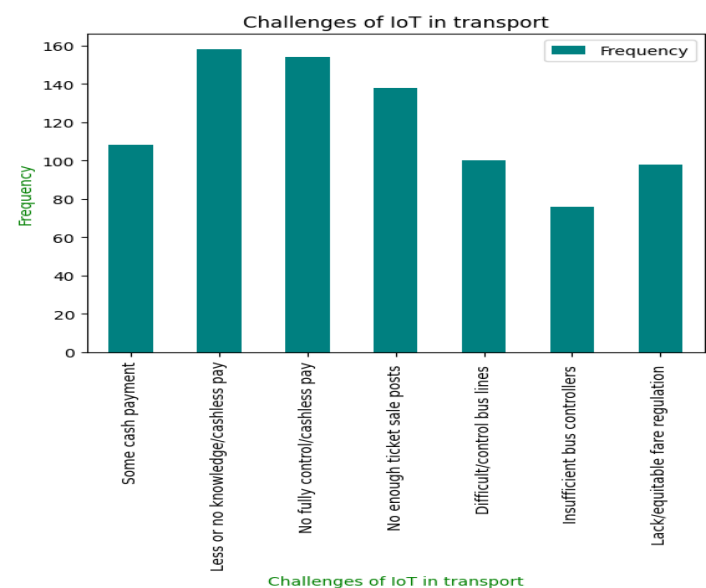|	Challenges_transport	Frequency
0	Some cash payment	108
1	Less or no knowledge/cashless pay	158
2	No fully control/cashless pay	154
3	No enough ticket sale posts	138
4	Difficult/control bus lines	100
5	Insufficient bus controllers	76
6	Lack/equitable fare regulation	98

Fig 5. Challenges of Using Iot in Transport

> The dataset used was from the machine where they were stored. We first imported dataset with use of CSV library called "Challenges_iot.csv".
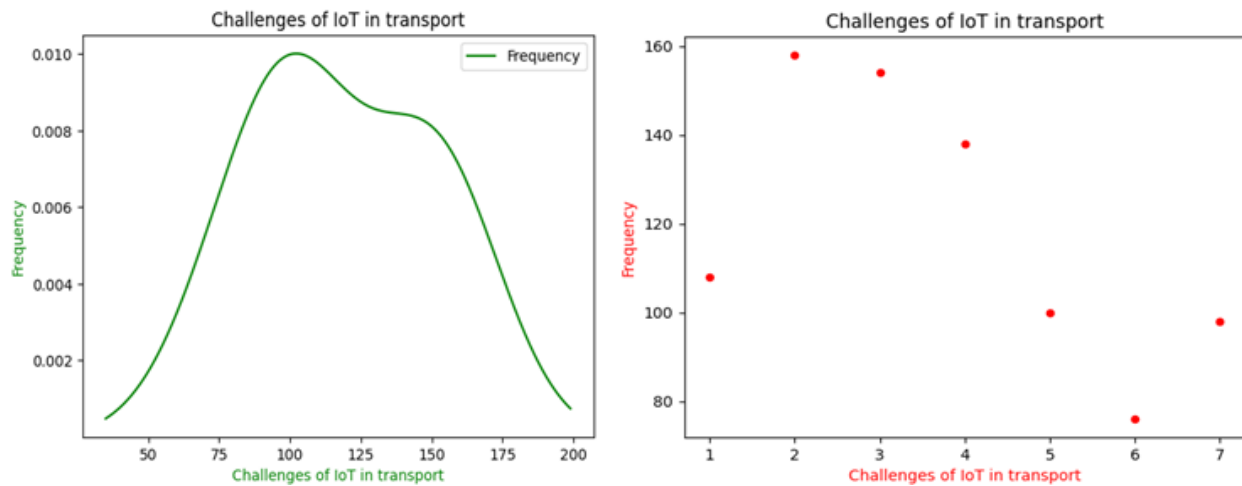
Fig 6. Challenges of Using Iot in Transport

➢ Information in the Figure 6 show different graphs generated using: a, b – linear regression, and b – lasso regressor. The graphs were represented with the same data retrieved from the same dataset so to have the data represented using different models.

• Effects of Using Iot in Transport

Table 3. Dataset: Effects of Using Iot in Transport

	Effects_transport_iot	Frequency
0	Quality of service delivery	157
1	Quality of transport	162
2	Use of smart transport	171
3	Stable Mgmt of transport	111
4	Enhanc. financial security	140
5	Encour. use of public transport	168
6	Stability of value/currency	132
7	Reduced theft of pass. prop.	83
8	Awakening of using IT	171

Fig 7. Effects of Using Iot in Transport

V. CONCLUSION

The drive of this research was to discuss the effects that IoT might have on transport in Kigali City, mentioning its implications, challenges and technical solutions. During this research, different methods and techniques have been employed to collect and analyze data. The main objective of this study was to discuss the effects that IoT might have on transport in Kigali City, mentioning its implications, challenges and technical solutions. This study was a success in terms of achieving specific objectives that were set at the beginning of this journey, including but not limited to studying technologies currently used for transport in Kigali City, investigating the challenges faced by transportation for customer service delivery in Kigali City, conducting the analysis of Internet of Things skills, and finally evaluating the effects of IoT technology for transport in Kigali City. Researcher consulted experts opinions and publications on this subject and compiled a model simulation with Python Programming Language for laying a discussion that can be used to assess the effects that IoT might have on transport in Kigali City. The researcher has shown how the research contributed to the existing knowledge for the new ideas generated during this study. The data gathering instruments included structured questionnaires and document review. The research has recommended different personnel including future researchers and transport actors.

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