

A Framework for an Electronic Marketing Delivery System Using Drone

Nanwin, Domaka Nuka¹ Ofor, Williams Daniel², Ekuase, Uwaguosa Endurance³

^{1,3}Department of Computer Science, Ignatius Ajuru University of Education, Rivers State, Nigeria

²Department of Computer Science, Rivers State University, Rivers State, Nigeria

ABSTRACT – The Novel COVID-19 global outbreak has further increased the benefits and importance of business continuity in challenging scenarios like this pandemic. The impact of technology in the marketing system cannot be over emphasized. This project work has explored the use of the unmanned aerial vehicle (UAV) popularly known as drone in an electronic marketing delivery system to improve the delivery services offered by online shops/ e-businesses which encourages speed in the delivery of goods/ items. A model has been created for the implementation of this system. The Geocode and general Google map API has been used to get a marker for the source and destination on the map that tracks the longitude and latitude of the delivery destination delivery location. The development of the system has focused on the development of the software and not the synchronization of the software and the drone. The system has performed well meeting all the demands of the process.

Key Words: E-marketing, Online Delivery System, E-commerce, Last-Mile, UAV, Geocode.

I. INTRODUCTION

The electronic marketing system has been around for more than a decade now and has improved the marketing system of businesses and corporations in no small way. Today, businesses, establishment and/ or corporations can do marketing of their goods and services with greater ease more so with the revolutionized innovation of the social media. The recent novel COVID-19 pandemic outbreak also has made things more obvious that with the help of the internet, electronic marketing has improved business continuity without physical presence. The use of technology has impacted greatly the possibilities in doing business more efficiently which in turn should revolutionize the supply chain framework; a process, businesses uses to convey their products from the beginning (source) to the product delivery to the customer (destination) which is very important and significant in this era (Kovac et al., 2017).

Electronic marketing is the marketing that is done online either through the websites, interactive TV, opt-in emails, smart mobile phones, online ads, social media platforms etc. Its major aim is to get as close as possible to the customers to understand them and maintain a channel of communication with them (Smith & Chaffey, 2008). These transactions in goods and services extend e-commerce that has to do with the supply chain management and business-to-consumer sales (Kutz, 2016). The use of the internet, computer devices as well as smart phones and the social media platforms has turn out to be an essential part of our daily lives and the key component of the electronic marketing (Dehkordi et al., 2012; Nezamabad, 2011). The rate at which customers' demands are increasing, there is need to also meet their demands by increasing how products are delivered to customers by employing the services of the courier service like the DHL, UPS, FEDEX, etc (Yazdanifard et al., 2011).

The main idea of this system is the delivery of goods to the respective customers. Since, a business on the internet is not complete if the recipient of that product does not get his/ her products or services delivered. This means, the cycle is complete when product and services are completed by way of delivery. The failure or delay of this delivery process is a thing to look into (Yazdanifard et al., 2011). As demands for promptness and timely delivery of courier services increase but are dominated by the conventional vehicles. The effectiveness of these services are beginning to attract a lot of questions for want of speed and because of the increase in congestions in our roads, the problem continues to compound (Seakhoa-King et al., 2019). That is why attentions is shifting towards drone delivery system which is attracting the big names in the online business and e-marketing industry like Alibaba, Amazon, DHL, Google and in the developed countries like the UK, China, US etc. that have put on ground

substantial technical and public policy programmes so that drone delivery can come to stay and they have invested heavily towards this process (Xu, 2017; Seakhoa-King et al., 2019; He, 2015). UNICEF is also in this business of exploring this emerging technology as they are in their early stage of exploring the application of drone delivery (UNCF, 2019).

Drone is an Unmanned Aerial Vehicle (UAV) which is also known as a pilotless aircraft. Its operation is a combination of some other technologies like the Artificial Intelligence, computer vision, object avoidance technology etc. and it's being explored to revolutionise the services the courier businesses renders as demands are increasing and resources are scarce and are not adequately met (Insight, 2019; Nentwich & Horvath, 2018; Seakhoa-King et al., 2019). This novelty in innovation will boost the economy of any nation by way of saving cost (Seakhoa-King et al., 2019). While drones have been in use for over a decade now, an extensive collections of organisation (e.g. health care sector, agricultural sector, humanitarian aid and disaster relief, weather forecasting, maritime, etc.) are beginning to harness this technology for commercial purpose (Nentwich & Horvath, 2018) and the e-marketing delivery system is in the fore front, as they explore all options there is to making this a reality. The delivery drones are for logistics of small or light objects and it makes use of the GPS among other features for navigation and positioning which also help in the return trip of the drones to base where it took off from. It is advantageous in accelerated delivery time, accuracy and cost in goods delivery (Kambire et al., 2019).

The e-marketing system has been a success since inception and is still being improved upon. Even though the e-commerce which is more like the broader spectrum of the e-marketing system is constantly rising, there is need to also improve the delivery system to match the rapid increase in e-business (Kambire et al., 2019). The delays and sometimes failure in delivery faced in the delivery system has given rise to this emerging technology. Since, there is relatively ease in buying and selling that has increased the purchasing power generally (Yazdanifard et al., 2011), there is need for speed in delivery and the present rise in population which

has led to the congestions we face in our roads will not allow the possibility of goods to be delivered on time. And also, the fact that some places do not have a good numbering system especially in the African states, locating a particular destination is a challenge in some cases that has led to failure in delivery. Hence, the proposed system is advantageous in meeting these challenges. The aim of this project work is to develop a framework for an electronic marketing delivery system using drone. To achieve this, the following objectives were considered: an awareness of the capabilities and importance of this new technology was carried out, a model for the framework of the delivery system was created, a framework for e-marketing delivery solutions were designed, implemented and an evaluation and analysis was done on the system. The rest of the paper is as followed: section II is the Literature review of the system, section III is the system analysis and design, section IV is the discussion of result and section V concludes the work.

II. LITERATURE REVIEW THEORETICAL FRAMEWORK

The internet is among the few things that have dramatically and immediately impacted on the lives of people and their businesses by providing more opportunities and enhanced businesses in a practical manner and cost-effectiveness (Nezamabad, 2011). Svedic (2004) presented an e-business marketing strategy that provides simple-to-use, customizable features, advertising and trust building. The operations of e-marketing were x-rayed on how products and services are promoted and customer response as they looked at role of trust, adaption and customer satisfaction in mobile marketing, web marketing and the role of social media (Dehkordi et al., 2012). Kovac et al. (2017) looked at the significance and importance of a delivery system in e-commerce and came to a conclusion that the positive comments of customers among other factors in their analysis are very essential. Silva et al. (2017) introduced an era of drone powered solution as a new source of revenue streams as its usage is sky rocketing in many industries. The future of unmanned aerial system (UAS) was looked into by Cohn et al. (2017) in the business and commercial

world and what stake holders should know as they invest in this new evolving innovation. Brar et al. (2015) looked into the advancement in the technology of drones and their usage in the commercial world which brings about the believe that the normal delivery process is being interrupted by the drone delivery in the last-mile productiveness. The management of the revolution associated with UAS and the systematic review of the use of the airborne drones were considered by Merkert & Bushell (2020) as they looked at the direction of effective ways to control the UAS in the future. This innovative technology in logistics businesses has a significant influence on the mobility of goods and people and their performance.

REVIEW OF EMPIRICAL STUDIES

Taking a look at various empirical studies, Knobloch (2020) presented a risk perspective in adopting drone delivery services as big companies make plans for the unmanned delivery drones. An external environment investigation was done on the commercial usage of drones by He (2015) looking at the GPS technology put together by his research group. In Wang et al. (2016) work, an important strategic essentials and their prioritization was the major focus in electronic retailers' home delivery supply's effectiveness enhancement. A graphical data analysis was presented on amazon prime air for a practical application and the cost-effectiveness (Pandit & Poojari, 2014). Seakhoa-King et al. (2019) presented the revenue aspect of drone delivery and time sensitivity service level as a summary of the Belgian unmanned aerial vehicle (UAV) ecosystem was presented by Culus et al. (2018) given the application and impact of drones across various section in Belgium. A workable regulatory framework for commercial drones was considered in Strieber (2018) paper and the impact of drones in large scale delivery without their externalities (indirect and external cost) Lohn (2017).

An automation and innovation in logistic processes of e-commerce was presented by Wozniakowski et al. (2018) giving the overview of recent use and the future of robotics in electronic commerce. Bappy et al. (2015) designed and developed a UAV for civil application using MATLAB/ Simulink to simulate the behaviour of the

drone. Customer perception on drone delivery services was done by Ayoubi & Ivanov (2019) basing their study on the unified theory of use and acceptance model. In a thesis presented by Desloovere et al. (2020) an investigation was done on the potential of drone delivery in contribution to last-mile logistic network as environment impact is being reduced. Studying the commercialization of drone mapping and sensing technology, Dai (2015) in his thesis has explored the market of the Norwegian researching on the ways and areas and areas drones can be used commercially to impact on their businesses and Welch (2015) was able to carry out a cost benefit analysis by the Amazon Prime Air that delivers goods to customer's door step using the drone system.

REVIEW OF RELATED LITERATURE

Hwang et al. (2019) presented a paper on the attitudinal impact of drone food delivery with behavioural intentions. UNICEF (2019) presented a study on how results of children can be delivered to them using the drone system. in a paper by Kim (2017) a delivery agent service system was presented using drones. Gohram (2017) carried out a strategic network design for delivery by drone in the fast growing e-commerce industry and e-retailers as they look as they look for innovative ways to deliver to their customers in the shortest possible time and at a lower cost. Looking at the massiveness of goods that are being delivered and the consumer space that is increasingly relying on fast and reliable delivery at the door step, a drone delivery system was presented by Kambire et al. (2019). Drones have been applied in the area of Agriculture; especially the e-agriculture. It has been used to dispense or for the application of liquid fertilizers, pesticides and herbicides (Sylvester, 2018). A last-mile delivery with drones was done by Chitta & Jain (2017) looking at the key attribute of speed, low cost of operation and environment friendliness. Wurbel (2017) carried out a review on the last mile delivery of vaccines with a framework evaluation of the cost effectiveness when drones are used. Dayarian et al. (2020) has looked at the potentials of same-day home delivery as powered by the unmanned aerial vehicles (UAV). Jenkins et al. (2017) has presented a technical and regulatory steps needed in order to make UAS package delivery a reality.

III. SYSTEM ANALYSIS AND DESIGN

The proposed electronic delivery system by drone is an innovative area of recent research gaining more and more attention in the academic arena. The idea behind this is to be able to deliver goods of a customer that made an electronic purchase by drones. The customer makes an online purchase and chose a drone delivery option because of the urgency, a form comes out for him to enter his/ her GPS location and a facial capture is initiated or a picture is uploaded for identity purpose. After all necessary detail has been taken the customer submits the form. Immediately, the sales representative of the online shopping company process the order and attach the goods to the drone, gets to the system and enter the GPS location of the customer and get the drone on air with a delivery and return command to the drone. When the drone locates the place, a facial recognition scan is done to be sure that the person receiving the parcel is who should receive it and the drone returns back to take off point. Figure 1 demonstrates the architectural framework of the proposed system.

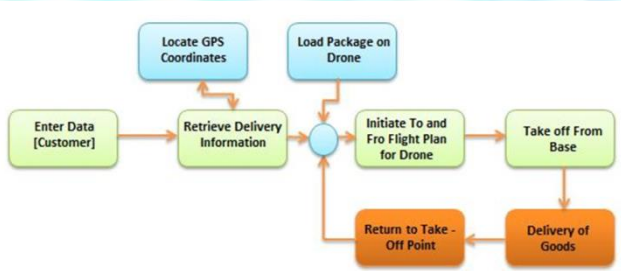


Figure 1: Architectural Design of Proposed System

Figure 1 presents an architectural design of the proposed electronic marketing delivery system using drone. The customer provides personal information on delivery and submits to the system, the system automatically retrieves the information, gets the GPS coordinate. The customer’s package is made ready and attached to the drone while the admin initiates a to and fro flight plan for the drone. The drone takes off, locates the customer, deliver goods and returns to take-off point; ready for another delivery.

METHODOLOGY AND DESIGN

The electronic marketing delivery system has used the conceptual design methodology and theory in its application. This methodology is used in the beginning phase of a simile complex product execution

process not considering its function only but, also looking at the impact it will have on the domain of application. The path through which the research work has been used to formulate challenge and objectives, has also been used to demonstrate the result (Sileyew, 2019). This method was adopted because the design process follows the analytical and systemic method (Draghici & Banciu, 2004) and the decision made while employing this methodology influences significantly on the success of the developed product (Cao et al., 2013).

The proposed system design is to show the practicability of using drones in the delivery process of an electronic marketing. The online shop has the responsibility in making sure that the ordered goods/ package information required is entered correctly. To make sure the system meets its development goal, some diagrams are used for proper illustration and explanation. In Figure 2 and Figure 3, Use Case diagrams have been used to further explain the system and a flow chart that demonstrate the flow of controls in Figure 4.

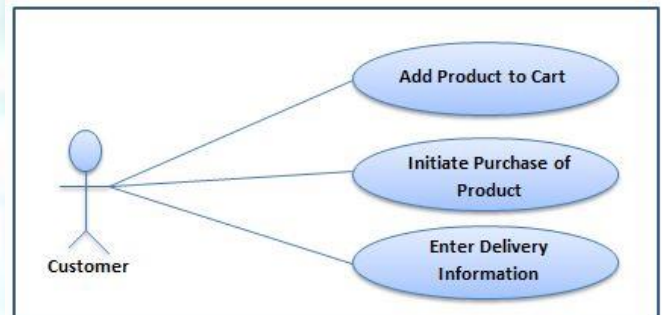


Figure 2: Use Case Diagram of the Proposed System

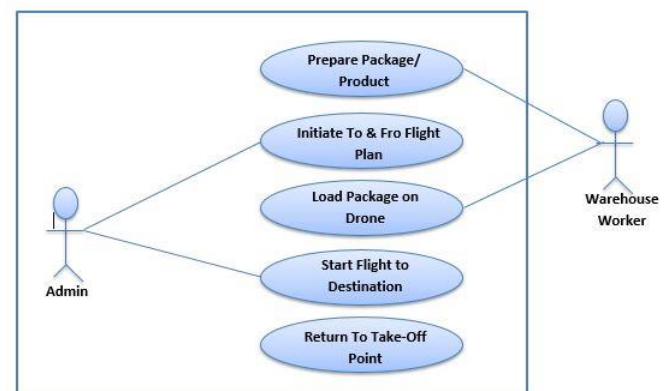


Figure 3: Use Case Diagram of the Proposed System

Figure 2 and Figure 3 presents the use case diagram of the proposed system which shows the actions of the actors. Figure 3.2a represents the actions of the customer making order through the system and

providing delivery information. Figure 3.2b shows the actions of two actors in the proposed system. The Admin is responsible for the initiation of the flight plan and starting of the take-off of the drone while the warehouse attendant or store keeper loads the package on the drone and prepare the drone for take-off.

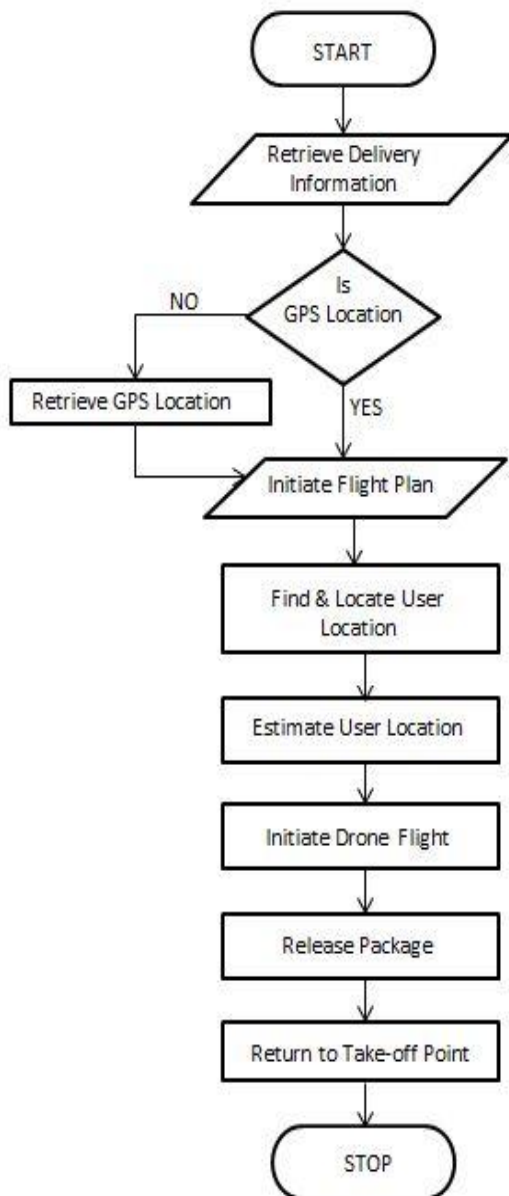


Figure 4: Flow Chart Diagram of the Proposed System

Figure 4 is the flow chart of the proposed electronic marketing delivery system using drone. It gives the step by step procedures of the flow of

control in the system. From the retrieved information of the customer, the GPS location is gotten and that is what the system uses to locate the customer’s position. If the GPS location is not found, the system iterates until it gets the GPS location and the distance between the source and destination is then estimated. The drone takes off to the destination and back to take off point.

IV. DISCUSSION OF RESULTS

The software was tested using a web based offline server to simulate the different aspect of the system. The registration and the login by the customer were done and the customer is able to add items to cart so as to check-out on a later date or immediately he/ she is ready to make purchase. During purchase of the goods, the customer address details are capture into the system so that the customer details can be gotten by the admin for delivery purposes. The source and destination marker on a map was also captured during the development of the system and a system for monitoring the drone flight progress is built into the system. The testing of the system showed that the software is functioning as expected with all the various interfaces like: the checkout of item(s), source and destination marker, the initiation of the flight plan, the monitoring screen etc.

The developed system of the proposed electronic marketing delivery system using drone has performed successfully as expected. Though, the drones were not used in the simulation and testing process of the system, the work was based only on the theoretical and simulation of the software aspect of the system and not with the drones. Hence, the system has performed as expected meeting the objectives of the project work. The Architectural design in Figure 1 and implementation architecture in Figure 5 presented the model and/ or framework in which the system is built on; illustrating the major objects in the operation and function of the software. The source and destination marker on the map is another vital aspect of the system that has enable the calculation of the flight duration and the delivery location using the GPS positioning system provided by the google map. The system gets the customer’s address and encode it using a JavaScript function to

make https request to the Google Map Geocode (GMG) apt endpoint. The response is then parsed from the https request retrieving the Longitude and Latitude with which the destination location is marked with the location marker on the map. With this, the distance can be calculated and the time the drone will take to complete one trip can be estimated.

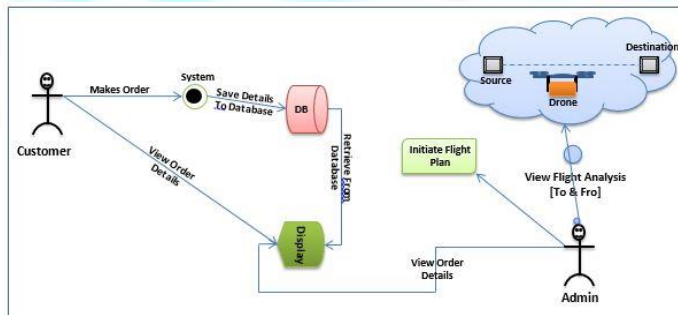


Figure 5: Implementation Architecture of the Proposed System

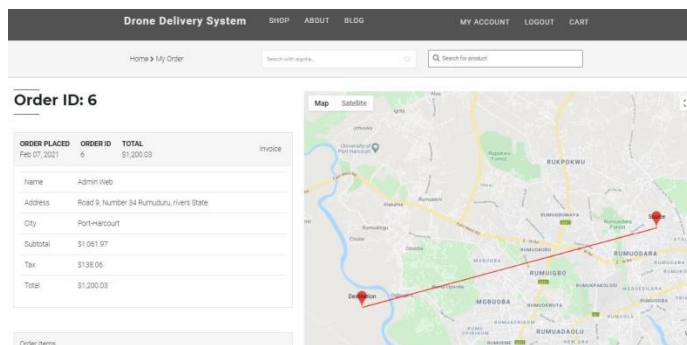


Figure 6: Order Preview Marker of the developed System

Figure 6 is the order preview of the developed system showing the source and destination marker on the map with a line drawn from the source to the destination. It is from this page the admin initiates the flight plan for the drone.

V. CONCLUSION

A framework for an e-marketing delivery system using drones has been established in this project work. This work has further strengthened the capability of the application of the technology in our e-marketing delivery systems. A model for the

framework has been created to foster the possibility of the design and implementation of this system. The simulation of the system produces an effective and efficient flow of process with the implementation of the Geocode and general Google Map API. Therefore, electronic marketing delivery system using drone would be of great impact to the delivery system if it is considered by the online marketers as part of their delivery system especially in last mile deliveries.

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