Drone Tracking Modelling Ontology for Tourist Behavior

Jack Febrian Rusdi¹², Sazilah Salam¹, Nur Azman Abu¹, Shahrin Sahib¹, Muchammad Naseer², Abdul Aziz Abdullah³

¹ Fakulti Teknologi Maklumat dan Komunikasi, Universiti Teknikal Malaysia Melaka, Durian Tunggal, Melaka, 76100, Malaysia
   E-mail: p031710033@student.utem.edu.my, sazilah@utem.edu.my, nura@utem.edu.my, shahrinsahib@utem.edu.my
² Informatic Engineering, Sekolah Tinggi Teknologi Bandung, Bandung, Jawa Barat, 40235, Indonesia
   Email: jack@sttbandung.ac.id, naseer@sttbandung.ac.id
³ Computer and Informatics Engineering, State Polytechnic of Jakarta, Depok, Jakarta, 16425, Indonesia
   Email: abdul.aziz@tik.pnj.ac.id

Abstract. Availability of internet access is one of the needs for tourists when traveling. Unfortunately, the availability of access is quite limited when in a tourist destination, usually Wi-Fi also generally uses a closed system that cannot be accessed by just anyone, except those who get access keys only. This paper provides a solution for the model of internet access for tourists provided by Tourism Service Providers, by utilizing drone technology as an access point. In addition, this model also provides services to track the position of tourists who spread and facilities for communication between tourists, especially for certain conditions, such as the occurrence of saturation for tourists while in one of the tourist destinations.

Keyword. Drone, Ontology, Tourist Tracking, Tracking Technology, Tourist Behaviours.

1. Introduction

Information technology is the backbone of the world of tourism, various facilities can be provided through these devices, so that various tourism strategies also consider services through this digital world [1]. Developments from various fields of technology that support, grow and provide many alternatives for human needs and knowledge, such as how drones can participate actively in the field of intelligence, how drones can move independently, drones, and Internet of Things (IoT) devices and sensors [2]. Drones can be used as wireless network access points because of the flexible nature of this technology as an Unmanned Aerial Vehicle (UAV) [3]. The use of IoT is growing quite rapidly, and has great potential benefits for the future [4].

In the field of tourism, for tourists, it has become a necessity, especially with a high level of internet usage during tourist trips both for tourists themselves and for tourist travel managers [5]. However, internet access as a support, especially for tourists is not easy to obtain, especially with the limited access of Wi-Fi available at tourist sites, both limited to the entrance to the system on access points and the limitations of the coverage area.

This paper aims to provide a solution to the use of Drones as tourist access points provided by the Tourist Travel Bureau and as a tracker of tourist presence while in tourist destinations. The discussion of the paper was made in the form of ontology from the technology model.
In a summary, the core of the contribution of this paper is in the following aspects:

1. Analysis of the literature.
2. System Model for analyzing tourist patterns in the field
3. Discussion about Drone support as an access point to the internet for tourists.

Furthermore, in writing this paper, we compiled the following. In section 2 discusses Drone Technology and Wi-Fi access points. In session 3, the Wi-Fi model ontology was discussed. In session 4 as a conclusion.

2. Drone Technology, mobile Wi-Fi access point, and Method

In this section, the discussion of the paper focuses more on drone technology, Wi-Fi access points, and methods, specifically related to the use of drones as access points for internet users.

2.1. Tourist Behavior

Tourist behavior can be learned from three time schemes, namely before the trip, during the trip, and after the trip is completed. Tourist behavior when in the field can be studied with technology such as physical response patterns [6] or based on their movement patterns in the field (e.g. [6]–[9]). The pattern of tourist movements in the field can estimate emotional levels and satisfaction [6]. Tourist emotional levels can be grouped into categories such as neutral, happy / pleased with in destination, calm or relaxed for their tour, tired where they need some sleep, distressed or frustrated condition, bored or depressed, dissapointed, and also fearful / alarmed [6].

2.2. Drone Technology

The use of drones has been applied in many ways, especially these types of devices that are Unmanned Aerial Vehicles (UAV) (e.g. [10]–[12]). Drones are inserted into a new type as a platform for remote sensing [12]. Judging from the price, this device includes a price that is inexpensive, easy to use, and can be used in a variety of options.

The application of drones can be done in various choices such as sensing, coordination, communication, and network (e.g. [11][13]).

In its development, research in the use of this technology has provided many opportunities, so that drones provide various capabilities. One of them, in terms of entertainment, was used as a medium for entertainment during the opening of The 2018 Winter Olympics, Pyeongchang, South Korea [2]. The application of the Drone Delivery System to Environmental Pollution was examined by Koiwanit [14] applied in Thailand. In the field of tourism, drones have been used in various forms, including the use of drones for specific genres of photographs or videos [15], See the sights by air with drone tourism [5], Interaction Between on a Protected Destination System and Conservation Tourism in the form of remote sensing [16].

The use of drones or multi-UAV based systems can be seen from various sides, such as resilience, the ability to adjust from the location, efficient use of resources, scalability, collaboration between devices, heterogeneity, and availability for equipment configuration [11].

2.3. Wi-Fi mobile Network

Development of area coverage from radio area networks, such as Wi-Fi can be done using a drone device [13]. This device is equipped with supporting network technology [17][18]. The ability of drones can be implemented as an access point in supporting the use of the internet network for tourists, especially seeing the behavior of tourists in the field who need a network of their tourism activities, such as communicating, taking moments of trips and documenting their social media [15].

2.4. Ontology

As a research fundamental, ontology discusses the explicit and formal specification of a concept ([19] p 21). Basic philosophical research in the field of engineering has been applied in several researches to view ontology as a strong element as prospective, which is closely related to the functionality of a system, realized through prototypes that are further developed ([20] p 135).
Xia [21] examine the modeling of the spatio-temporal movement in tourists, looking at the ontology at least from two points of view, namely from an objective and subjective side. The objective side of tourist travel is seen as from the tourist side, travel model, and physical tourist movements. While from the subjective side is about the decisions of tourists that are sometimes difficult to predict, such as the relevance of tourists to the decisions they make.

Objective aspects can include Who, Where, When, dan How. While the Subjective point of view is seen from the point of view Why [21]. Who in this model are tourists and Tour Leaders. Where is where the system is implemented, namely in the field or in tourist attractions. When talking about time, that is when a tour is done. Whereas how is talking about how this model is applied.

Research using the ontology concept was also carried out by Insaurralde and Blasch [22] who raised the operation framework and ontology-based process related to advances in aeronautical informatics, they called it Avionics Analytics Ontology (AAO) in the Air Traffic Management system, including in the management of Unmanned Aerial Systems (UASs).

Other than that, Parreiras [19] also uses ontology in his book that discusses semantic web and web model-driven engineering that represents knowledge. One focus is the importance of ontology engineering in the development of two paradigms such as model transformation and specific modeling.

2.5. Method

The method used in this study is to take some literature from previous research. Previous research related to the tourist behavior, Drone Technology, Wi-Fi mobile networks, drone tracking modeling, and ontology concepts applied in tourist tracking. From this, a model was proposed through this research.

3. Drone Tracking Modelling Ontology and Model of Mobile Access Point for Tourists

3.1. Modelling

The method used in this model is the provision of facilities for tourists and tourist guides in guiding groups of travel participants in managing their trips while visiting a tourist spot.

When at tourist sites, tourists are given access to use the internet. They are also connected with a tourist information system. The behavior of tourists who can spread can be monitored by the Tour Leader through a tourist information system, such as the movement of tourists, including communicating with tourists through the application found in the application layer. Tour Leaders can also track the spread of tourists in the field based on dataset tracking obtained from the tracking system on the mobile device used by the tourist. This method can be explained through Figure 1.

![Figure 1: Modelling of Drone Tracking and Mobile Access Point](image)

In this Drone Tracking Modeling for Tourist Behavior study, a model that can track tourists is managed by the Tour Leader. The system provides internet access facilities through access points provided by Tourist Travel Companies, access points are provided through drones. An overview of this model can be seen in Figure 1.
3.2. Ontology Concept

Judging from the concept of ontology as discussed by Xia [21], four components of objective ontology are tourists (who), where tourists travel and where they are, how they travel whether alone or in groups or other forms or from the technology side of how to manage tourist travel by using drones as an access point (how), and when when special attention to tourists is given when running tourist trips in tourist destinations (when). The concept of ontology can be seen in Table 1.

| Type     | Component | Description                                                                 |
|----------|-----------|-----------------------------------------------------------------------------|
| Objective| Who       | Tourist, Tour Leader                                                        |
| Objective| Where     | On the field when traveling                                                 |
| Objective| How       | How tourists spread, and how drones can be used as access points in controlling tourist trips at tourist sites |
| Objective| When      | When special attention needs to be followed up, for example when travel patterns are indicated to start boring for tourists. |
| Subjective| Why      | When there are indications of boring patterns for tourists to emerge, it needs to be confirmed through communication, whether this pattern needs to be anticipated immediately, such as by completing the visiting session at that location. |

From a subjective perspective, this tracking system can provide information that can be a view for the Tour Leader on the condition of tourists when on the field, whether they are active, or passive. Active in the sense that the tourists move from one place to another from the points that exist in the tourist attractions. While passive in the sense, the movement of tourists has begun to weaken, or low, for example there are many who are only at one point both individually and in groups, which can be interpreted that tourists are getting bored in that place, so the Tour Leader can ensure with communicate through the facilities provided, whether they will end the visit at the place so that they go to the next place, or still remain at the tourist site. Thus, service and satisfaction with services through this control will be able to provide added value to the concern for tourists managed by the company through Tour Leaders in the field.

3.3. System Layer

In this concept there are four layers of the system, which consist of Server Layer, Application layer, Network Layer, and User Layer. The layered system structure can be seen in Figure 2.
Server Layer is a place for processing incoming data from tracking records or information originating from outside the server. The Server Layer stores datasets and everything on the event record that is considered important by the system. In addition, the Server Layer also contains various Web-Server applications or waiters for requests for information needed by users. In this Web-Server application is stored that manages activities related to tracking or communication.

In the Application Layer there are various modules related to the tourist information system, in this case such as management of communication between users, personal identification, tracking datasets or various other tourist information system service modules.

Network Layer is an area of media that transports data between systems in the system and users in the field, including Drones - Routers - Routers, Access Points - Routers, and Mobile Operators. Drones - Routers are responsible for connecting between users in the field with the system wirelessly, especially when tourists are at tourist sites. Access Point - Router is used as a liaison with mobile operators that provide internet connection services. Besides that, an Access Point placed on a vehicle can also be a liaison with the user while in a vehicle. Drones used in this system could at least interact with both fellow drones and users in the field, coalition in service, connected with tourist information systems.

While the User Layer is a layer of users who are in the field such as tourists who are managed by tourism service companies, or Tour Leaders who manage tourist trips in the field. Tourist and Tour Leader through remote mobile application, the system also tracks tracking datasets through mobile devices[23]. Remote applications are developed including using mobile content[24].

3.4. Algorithm

From the side of the algorithm that are of concern in the modeling of this system are:

1. User authorization. Authorization is done through the application installed on the tourist mobile device or the Tour Leader. Authorization based on user data that is validated via email or by tourist telephone numbers.

2. Registration of tourist presence. Tracking datasets about the location of tourist's location are obtained from geographical positions taken from GPS coordinates.

3. Communication facilities between tourists and Tour Leaders. Communication facilities are part of the tourist information system, as a place for tourists with Tour Leaders to communicate with each other about their travels. Each conversation is stored in a database placed on the server.

One of the references in understanding the tourist behavior while on the field is mobility and movement of tourist movements. For example, tourists who generally keep quiet in a location need special attention to the Tour Leader, whether these conditions indicate that tourists are in a negative condition with the conditions at the time, so the Tour Leader can communicate with tourists.

4. Conclusion

This research provides a model in managing tourist travel, especially to optimize services for tourists, such as providing internet access services that can be used by tourists when traveling. The device used is a drone equipped with capability as an access point, so that mobile devices owned by tourists can be connected to the internet through this compiled model. Besides that, this model can also be used to determine the pattern of tourist movements in the field.

For further research, the following points need to be optimized. In the use of drones for a long time, the next study is in terms of increasing the limited battery capacity currently. In order for the use of drones to be flexible, the size and weight of the drone needs to be optimized at a reasonable size and lighter. Besides the range of controls or inter-control of certain drones with greater distances.

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