

UNIVERSITI TEKNOLOGI MARA

**DRONE IN DISASTER VICTIM
IDENTIFICATION:
OPTIMISING AND
CHARACTERISING THE
EFFICIENCY, AND DNA
PROFILING IN DRONE-ASSISTED
VERSUS CONVENTIONAL
PROCEDURES**

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ABSTRACT

Post-disaster environments present significant challenges for Disaster Victim Identification (DVI) process. Searching for dead bodies caused by disasters could be a challenging and time-consuming operation, causing delays in retrieving and transporting dead bodies to the mortuary which can result in body decomposition, leading to DNA degradation and adversely impacting the DVI process. Drones have been widely deployed in disaster operations due to their multidimensional capabilities, but there has been limited research on their applications in assisting the DVI process. To address this gap, this study investigates the capabilities of drones in DVI operations by comparing the efficiency of drone-assisted versus conventional procedures in collecting and analysing the primary (e.g., DNA) and secondary identifiers (e.g., personal belongings). This study aims to determine the practical drone heights and camera lens specifications to capture images of secondary identifiers onsite, using two drone models: DJI Mavic 2 Zoom (M2Z) and DJI Matrice 300 RTK (M300). The quality of DNA samples transported by drone and analysed using RapidHIT ID (RHID) onsite was also studied. The study design of this research is a comparative cross-sectional study. The Secondary Identifier DVI Scoring Card (SIDSC) was introduced to collect secondary identifier data in drone-assisted procedures. The data was assessed between different settings, drones, observers and comparable parameters of other forms. DNA samples processed by RHID were compared to those analysed using conventional methods based on the number of alleles observed versus expected to determine the kinship and concordance rate. The time taken for these procedures were also evaluated. Results of this study have shown that 5 m height with a 48 mm lens for M2Z drone, and 50 m height with a 20x zoom for M300 drone produced optimal image quality and orientations. The application of SIDSC was found reliable in drone-assisted procedures, as demonstrated by intra-operator and inter-operator precision analyses ($p > 0.05$). When comparing data between drone images and the external post-mortem (PM) examination, no significant differences ($p > 0.05$) were observed. DNA samples collected onsite and transported via drone to the mobile lab for processing by RHID yielded 100% complete profiles ($n=20$), meanwhile, samples that were collected at the hospital mortuary produced 80% complete profiles ($n=16$). The kinship matching rate between the victim and their relative profiles generated by RHID is 89.77% compared to conventional method with 79.62%. RHID also had a concordance rate of 88.24% compared to the conventional procedure. Drone-assisted procedures were also reported to be generally faster than the conventional procedures conducted at the mortuaries. In conclusion, drone-assisted procedures were not only quicker in collecting and analysing primary and secondary identifiers but also produced results comparable to those of conventional procedures. Images from the M300 drone have better quality than the M2Z drone but both were considered comparable with external PM examination at the mortuary. Additionally, drone-assisted procedures enable data collection to be conducted early onsite before evidence is lost or destroyed. Lastly, the combination of drones and RHID can expedite data collection and analysis, mitigating the impact of DNA degradation due to body decomposition.

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TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF PLATES	xiii
LIST OF SYMBOLS	xiv
LIST OF ABBREVIATIONS	xv
LIST OF NOMENCLATURE	xviii
CHAPTER 1 INTRODUCTION	19
1.1 Research Background	19
1.2 Problem Statement	21
1.3 Research Questions	22
1.4 Research Aims	23
1.5 Research Objectives	23
1.6 Scope and Limitations of the Study	24
1.7 Significances of Study	24
CHAPTER 2 LITERATURE REVIEW	26
2.1 Disasters Overview	26
2.1.1 Disasters in Malaysia	27
2.2 Disaster Management	28
2.2.1 Disaster Management in Malaysia	29
2.3 Disaster Victim Identification (DVI)	31
2.3.1 DVI Phases	32
2.3.2 Means of Identifications	36

CHAPTER 1

INTRODUCTION

1.1 Research Background

Given the geographically stable region outside the Pacific Ring of Fire, Malaysia is relatively free from severe disasters such as tsunamis and earthquakes, which frequently affect neighbouring countries like Indonesia (Martin, 2019). However, in recent years, Malaysia has experienced a series of unfortunate disasters, including a devastating flash flood that impacted eight states across peninsula Malaysia in December 2021, followed by a tragic landslide in Batang Kali, Selangor in December 2022 which claimed the lives of 31 people including children (Hakim et al., 2023). These incidents have highlighted the increasing exposure of Malaysia to frequent disasters, emphasising the urgency of implementing a comprehensive and well-prepared disaster management plan including handling dead bodies.

When a catastrophe strikes, they cause austere and very costly damages, the loss of life and property along with livestock and agricultural devastations. The effects are of such scale that they cannot be dealt with by the emergency services and local authorities as part of their everyday activities, requiring the mobilisation and organisation of special and extra services such as the first responders (Wecht & Okoye, 2007). Furthermore, searching for dead bodies in mass fatality incidents has always been a challenging and time-consuming process for the first responders since it often requires a thorough exploration of geographically varied and large areas of the catastrophic site.

Disaster Victim Identification (DVI) is a formal process whereby multiple individuals who have died due to a mass mortality event will have their identity established through scientifically proven techniques. Victim identification involves collecting and analysing a series of scientific evidence known as primary identifiers e.g., fingerprint, dental, and DNA analysis; secondary identifiers include personal belongings, medical records, and evidence found on the dead body (INTERPOL, 2018a). A swift retrieval of primary and secondary identifiers allows the identification process to be more efficient and effective, leading to the rapid release of deceased individuals to their grieving loved ones.