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Application of Internet of Things (IoT) and Artificial Intelligence in Unmanned Aerial Vehicles

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ABSTRACT- In the current era, to upgrade the facilities and features of UAVs, the implementation of IoT and AI is mandatory. It helps the drone to provide accurate data after analysing a particular situation. Moreover, it also helps to access the drone from any device with the help of an android app. The application of AI and IoT has enhanced the popularity of drones worldwide. This study has analysed the application of IoT and AI in UAVs to make them more efficient. This research has evaluated IoT and AI's positive and negative impacts on UAVs. Moreover, it has determined solutions to mitigate them effectively.

General Terms: Drone, Data breaching, android app.
Keywords: IoT, AI, Unmanned Aerial Vehicles (UAVs)

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1. INTRODUCTION

In the current era, people have highly addicted to the use of IoT and AI in their regular lifestyle. On the other hand, to make the operational activities more accessible and more effective, organisations like Amazon, Wind, Zipelionew, and FedEx are using Unmanned Aerial Vehicles (UAVs) or drones in the workplace. This helps the organisations observe the activities of the supply chain, workers, and other workplace sections. However, nowadays, technology experts are trying to implement IoT and AI in UAVs so that the users can get facilities of both AI and drones at a time. Since, until now, by implementing IoT and AI in the UAV, people have added automatic landing and takeoff of drones. Moreover, it has also allowed the users to access the drone from their mobile devices through the android app, for which the use of drones has been increased around the world [1]. This study will develop research regarding the implementation of AI and IoT in UAVs for further improvement. To do this job, the researcher would briefly share different secondary data, mathematical formulas, and drone algorithms throughout the study.

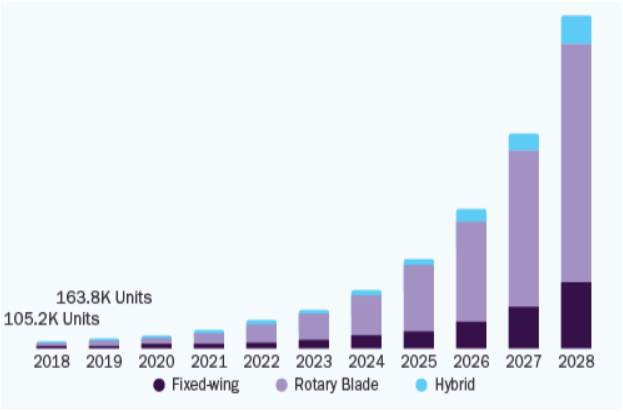

Figure 1: Increasing demand for UAVs in the world

2. LITERATURE REVIEW

2.1 Impact of the implementation of AI and IoT in UAVs on society

Nowadays, the implementation of AI and IoT in the drone has increased its power and effectiveness, which has made it eligible to use in different fields for different purposes. AI and IoT allow the UAV devices to automatically capture the workplace's actions by using the camera, such as employee performance, manufacturing of products, and so on [2]. It also helps the organisation deliver its products to the customers by avoiding the human touch. For example, Amazon prime used

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drones to make contactless delivery to customers with the help of AI and IoT [3]. Significantly, after Covid 19, implementing IoT and AI in the drone if Amazon Prime has highly increased its competitive advantages and popularity among its competitors and customers. Additionally, the implementation of AI in UAVs has allowed the users to access the device from their mobile phones through the android app, making drone access easier for all kinds of people [4]. As a result, people use drones for videography, photography, traffic monitoring and many other purposes. Hence, from this discussion, it has been evaluated that the implementation of IoT and AI in drones has positively impacted society by allowing people to access their job quickly.

2.2 Challenges of AI and IoT

The implementation of IoT and AI in UAVs has decreased the confidentiality of people, which has highly dissatisfied the society. However, the governments are developing regulations that analyse that a user has to make the lines before accessing the drone. Otherwise, they may have legal punishment [5]. Despite that, people are using drones without making a license, which hampers the personal life of ordinary people. On the other hand, a person has to take training from the technology experts to use a drone. Therefore, organisations interested in implementing drones in the workplace have to give training to their employees, which has increased the overall business cost [6]. Moreover, without proper training during the use of drones, employees are making mistakes, increasing the ratio of data breaches and legal violations in the world. Nowadays, 4.8 billion data breaches occur due to UAVs' wrong applications in a year [7]. Hence, it has been determined that lack of security, compatibility and standards are the challenges of applying IoT and AI in UAVs.

Figure 2: Challenges of implementation of IoT and AI in UAVs

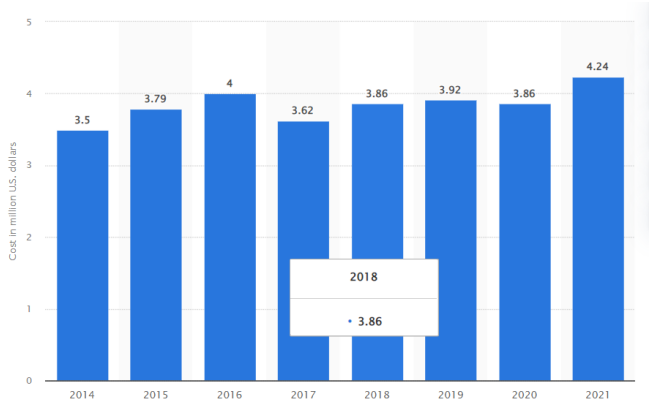

Figure 3: Increasing rate of data breaching in the world

2.3 Way to solve the challenges

To mitigate the misuse of drones, governments have to become more aware of their rules and regulations. Additionally, organisations also have to provide training to employees before giving them access to the drone [8]. It guides them to use the drone properly and reduces the number of data breaches globally. For example, Amazon, FedEx and Wing always give training to employees during the UAVs application so that they do not take any legal errors or data breaches by mistakes [9]. It has helped them to use the drone in the workplace accurately. Hence, it has been determined that providing proper training to employees and developing strict rules and regulations in the country can stop the misuse of IoT and AI in UAVs.

3. RESEARCH METHODOLOGY

Research methodology is a method which allows the researchers to collect and analyse accurate data to complete the research correctly [10]. In this case, only secondary data has been used by the researcher, where all data have been collected from articles, journals, e-books and websites. It has allowed the researchers to collect real-time data efficiently. Moreover, based on the secondary data collection, the researchers have done technical and secondary data analysis. The researcher used drone theory and different mathematical formulations from the secondary data during the technical analysis. This also helped to analyse the application of IoT and AI in drones with the help of python programming language.

4. ANALYSIS AND INTERPRETATION

4.1 Technical Data Analysis

Design UAV features by implementing IoT and AI
Context: IoT and AI implementation in UAVs
Infrastructure: Windows Server, 64 GB RAM
Platform: Python 3.8.

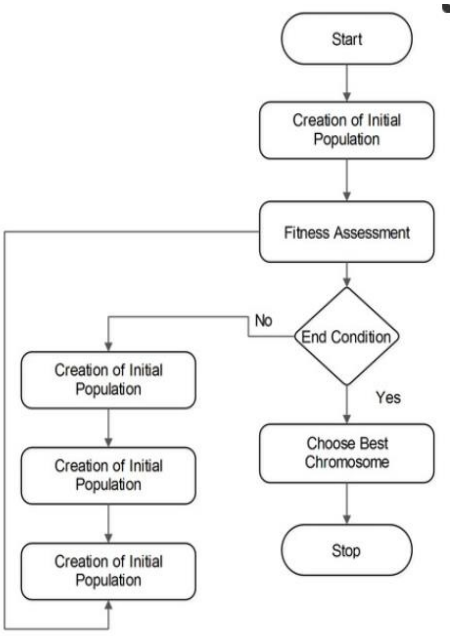

Figure 4(a): Genetic Algorithm

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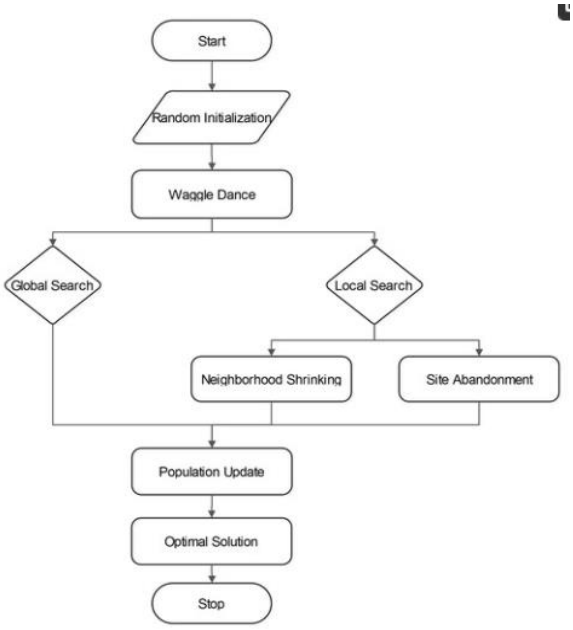

Figure 4(b): Bee Optimisation algorithm

4(a) and 4(b) have visualised the process of two routing algorithms, which researchers have used to do the technical data analysis. Genetic algorithm has allowed researchers to find the best outcome from existing and new data collaboration [11]. Moreover, it has allowed optimising the implementation problems of IoT and AI in UAVs. On the other hand, the Bee optimisation algorithm has allowed the researcher to identify the proper route of data analysis in the drone. It has provided accurate results from the data analysis procedure [12].

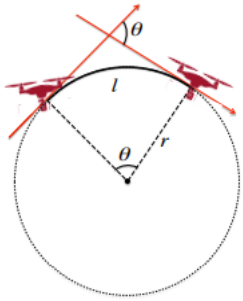

Figure 5 (a): Drone path during taking a turn

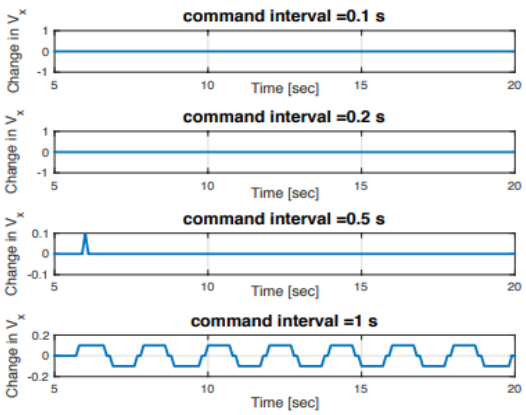

Figure 5(b): Drone velocity

Figures 5(a) and *5(b)* have visualised the path and velocity of the drone during the turning. Both of these figures have been developed based on the below-mentioned formula, which helps the drone to take the right direction based on the direction of the users.

$l=v.t$; $l=r.\theta$; $r=v^2/a$, where l is length, r is the circle's radius, and a is the lateral acceleration.

Code 1:

```
from drone kit import connect, Vehicle Mode, Location Global Relative
from pymavlink import mavutil
import time
import argparse
parser = argparse.ArgumentParser()
parser.add_argument('--connect', default='127.0.0.1:14550')
args = parser.parse_args()
print 'Connecting to vehicle on: %s' % args.connect
vehicle = connect(args.connect, baud=921600, wait_ready=True)
def arm_and_takeoff(aTargetAltitude):
print "Basic pre-arm checks"
while not vehicle.is_armable:
print " Waiting for the vehicle to initialise..."
time.sleep(1)
print "Arming motors"
vehicle.mode    = VehicleMode("GUIDED")
vehicle.armed   = True
while not vehicle.armed:
print " Waiting for arming..."
time.sleep(1)
print "Taking off!"
vehicle.simple_takeoff(aTargetAltitude) # Take off to target al
titude
while True:
print " Altitude: ", vehicle.location.global_relative_frame.alt
if vehicle.location.global_relative_frame.alt>=aTargetAltitude
*0.95:
print "Reached target altitude"
break
time.sleep(1)
arm_and_takeoff(15)
print("Take off complete")
time.sleep(15)
print("Now let's land")
vehicle.mode = VehicleMode("LAND")
vehicle.close()
```

Code 2:

```
from logging import debug
from modules import drone
from simple_pid import PID
import time
USE_PID_YAW = True
USE_PID_ROLL = False
MAX_SPEED = 4       # M / s
MAX_YAW = 15        # Degrees / s
P_YAW = 0.02 #orgineel 0.01
I_YAW = 0
D_YAW = 0
```

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```
P_ROLL = 0.22
I_ROLL = 0
D_ROLL = 0
control_loop_active = True
pidYaw = None
pidRoll = None
movementYawAngle = 0
movementRollAngle = 0
inputValueYaw = 0
inputValueVelocityX = 0
control_loop_active = True
flight_altitude = 4
debug_yaw = None
debug_velocity = None
def configure_PID(control):
global pidRoll,pidYaw
print("Configuring control")
if control == 'PID':
pidYaw = PID(P_YAW, I_YAW, D_YAW, setpoint=0)      # I = 0.001
pidYaw.output_limits = (-MAX_YAW, MAX_YAW)          # PID Range
pidRoll = PID(P_ROLL, I_ROLL, D_ROLL, setpoint=0)   # I = 0.001
pidRoll.output_limits = (-MAX_SPEED, MAX_SPEED)     # PID Range
print("Configuring PID")
else:
pidYaw = PID(P_YAW, 0, 0, setpoint=0)              # I = 0.001
pidYaw.output_limits = (-MAX_YAW, MAX_YAW)          # PID Range
pidRoll = PID(P_ROLL, 0, 0, setpoint=0)            # I = 0.001
pidRoll.output_limits = (-MAX_SPEED, MAX_SPEED)     # PID Range
print("Configuring P")
def connect_drone(drone_location):
drone.connect_drone(drone_location) #'/dev/ttyACM0'
def getMovementYawAngle():
return movementYawAngle
def setXdelta(XDelta):
global inputValueYaw
inputValueYaw = XDelta
def getMovementVelocityXCommand():
return movementRollAngle
def setZDelta(ZDelta):
global inputValueVelocityX
inputValueVelocityX = ZDelta
def set_system_state(current_state):
global state
state = current_state
def set_flight_altitude(alt):
global flight_altitude
flight_altitude = alt
def arm_and_takeoff(max_height):
drone.arm_and_takeoff(max_height)
def land():
drone.land()
def print_drone_report():
print(drone.get_EKF_status())
print(drone.get_battery_info())
print(drone.get_version())
#end drone functions
def initialize_debug_logs(DEBUG_FILEPATH):
global debug_yaw, debug_velocity
debug_yaw = open(DEBUG_FILEPATH + "_yaw.txt", "a")
debug_yaw.write("P: I: D: Error: command:\n")
debug_velocity = open(DEBUG_FILEPATH + "_velocity.txt", "a")
debug_velocity.write("P: I: D: Error: command:\n")
def debug_writer_YAW(value):
global debug_yaw
debug_yaw.write(str(0) + "," + str(0) + "," + str(0) + "," + str(inputValueYaw) + "," + str(value) + "\n")
def debug_writer_ROLL(value):
global debug_velocity
debug_velocity.write(str(0) + "," + str(0) + "," + str(0) + "," + str(inputValueYaw) + "," + str(value) + "\n")
def control_drone():
global movementYawAngle, movementRollAngle
if inputValueYaw == 0:
drone.send_movement_command_YAW(0)
else:
movementYawAngle = (pidYaw(inputValueYaw) * -1)
drone.send_movement_command_YAW(movementYawAngle)
debug_writer_YAW(movementYawAngle)
if inputValueVelocityX == 0:
drone.send_movement_command_XYA(0, 0,flight_altitude)
else:
movementRollAngle = (pidRoll(inputValueVelocityX) * -1)
drone.send_movement_command_XYA(movementRollAngle, 0,flight_altitude)
debug_writer_ROLL(movementRollAngle)
def stop_drone():
drone.send_movement_command_YAW(0)
drone.send_movement_command_XYA(0, 0,flight_altitude)
```

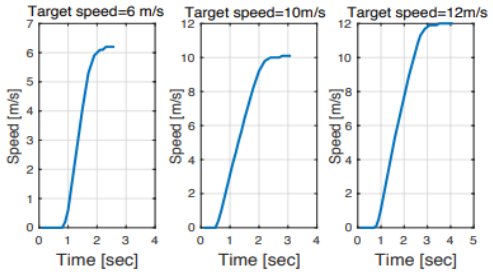

Figure 6: Drone Speed

The code mentioned above has evaluated the IoT code, which the researcher uses to control the drone and test its drone speed. The result of implementing regulations is figure 6, which assesses the rate of drones each second.

```
import jetson.utils
import cv2
cams = []
def create_camera(csi_port):
cams.append(jetson.utils.videoSource("csi://" + str(csi_port)))
def get_image_size(camera_id):
```

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```
return cams[camera_id].GetWidth(),
cams[camera_id].GetHeight()
def get_video(camera_id):
return
cv2.cvtColor(jetson.utils.cudaToNumpy(cams[camera_id].Cap
ture()),cv2.COLOR_RGB2BGR)
def close_cameras():
for cam in cams:
cam.Close()
if __name__ == "__main__":
create_camera(0)
while True:
img = get_video(0)
cv2.imshow("camera", img)
cv2.waitKey(1)
close_cameras()
```

Above mentioned code has analysed the principle of Camera accessibility, which allows the users to access the camera of the drone to capture the image of the workplace. With the help of this code, users can also access the camera of the UAVs from /her mobile device.

4.2 Secondary Data Analysis

Three constraints of IoT and AI, such as scalability, diversity and intelligence, have increased the accessibility of UAVs in the global market [13]. The construction industry uses drones to observe construction-related jobs during fieldwork. It helps them keep the construction mistakes, which may create significant risks in the future [14]. On the other hand, by using the situational observing features of drones, manufacturing companies are also using them in the workplace, which helps them analyse the employee activities, and employee safety and explore the stages of the product manufacturing procedure. However, the logistic industry has first started to use the workplace observation features of UAVs to identify the risk to the supply chain [15]. In the current era, it uses drones to make contactless delivery to customers, which has only been possible due to the implementation of AI. Additionally, the photography and videography industry also used drones to make their shoot more practical, realistic and unique. Hence, it has been determined that the application of AI and IoT in UAVs has increased its use in different global market sectors.

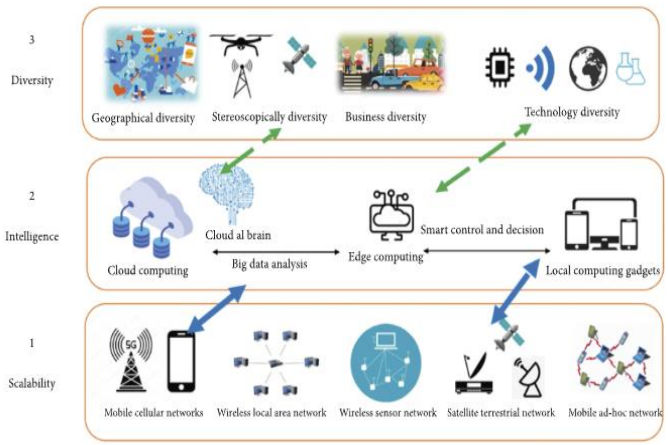

Figure 8: Constraint of IoT and AI

5. DISCUSSION AND FINDINGS

From the outcome of the data analysis, it has been evaluated that the advantages of IoT and AI in UAVs are incredible, which has given a new turnover to the technology world. It has allowed organisations to do their job more smartly by avoiding difficulties. Especially after the Covid 19, the application of drones has influenced the logistic industry and manufacturing industry to do their job by avoiding human contact. On the other hand, the construction industry has also become helpful by drones during the fieldwork monitoring by maintaining social distancing. Moreover, the valuable insights of technical analysis have determined that the implementation of AI and IoT has made them capable of the drone for automatic take-off, automatic landing and accessing the movement from the mobile devices. Hence, it has been analysed that IoT and AI in drones have given a fruitful outcome to all kinds of business platforms globally.

6. CONCLUSION

Conclusively, IoT and AI in UAVs have effectively increased their market demand. It has allowed users to access drones through their phones and other Android apps easily. Moreover, it has allowed the logistic industry, construction industry, and manufacturing industry to use a drone to observe all the work activities easily. However, due to a lack of legal effectiveness, some people use drones to affect other people's privacy. It has increased the data breaching ratio in the world. Since the government has to focus on the rules and regulation development to stop the misuse of UAVs by people, this research study has analysed brief data regarding the application of IoT and AI in UAVs with different technical and secondary data, which has increased the future scope of the study.

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