CHAPTER TWO

LITERATURE REVIEW

2.1 Guidance, Navigation and Control Systems (GNC)

Guidance, navigation and control is concerned about the design of systems to control the movement of vehicles, especially, ground vehicles, ships, air vehicles, and space crafts. Because of the speed of, for example, a rocket's dynamics, human response time is too slow to control the rocket. Therefore, systems based around digital electronics are used for such tasks.

Guidance is the determination of the right-track from the current location to the target, as well as desired velocity, rotation and acceleration for following that path. Navigation is the determination of velocity, location and attitude at certain point of time. Control is maintaining vehicle stability while tracking guidance commands to effect change in aerodynamic and/or engine controls [1].

2.2 Historical Review of UAV's

Carrying bombs to the enemy territories was the first idea in the history of unmanned aerial vehicles (UAVs). During the American Civil War, an inventor had an idea to use a balloon to carry and drop explosives on enemy using time-delay fuse mechanism to trigger the operation. Air currents and weather conditions made it difficult to estimate for how long to set the fuse, and the idea was never successfully deployed.

World War saw the development and testing of various radio-controlled unmanned aircraft, but none emerged from the testing phase in time to be used before the war ended. In 1930s, the British Royal Navy developed a radio-controlled UAV (The Queen Bee). The Queen Bee could be landed for future

reuse and could reach speeds of 100 mph (160 km/h). The Queen Bee primarily served as aerial target practice for British pilots.

During World War II, Nazis developed a UAV to be used against nonmilitary targets. The Revenge Weapon 1, an unmanned flying bomb better known as the V-1, could reach speeds of almost 804 km/h, carry 907 kilograms of explosives and could travel 241 kilometers. In towns and cities across Britain, the V-1 was responsible for more than 900 civilian deaths and 35,000 injured civilians.

In the 1960s and 70s, The U.S. employed UAVs called Lightning Bugs that were released from airborne C-130s for missions over China and Vietnam. Engineers from the manufacturer operated the aircraft with a joystick control. In the late 1970s and 80s, Israel developed the Scout and the Pioneer, which represented a shift t-oward the lighter, glider-type model of UAV in use today. The Scout was notable for its ability to transmit live video with a 360-degree view. The small size of these UAVs made them inexpensive to produce and difficult to shoot down [2].

2.3 Applications of Unmanned systems

2.3.1 UAV's:

- **Commercial surveillance**:
  Surveillance applications include livestock monitoring, wildfire mapping, pipeline security, home security, road patrol, and anti-piracy.
- **Oil, gas and mineral exploration and production:**
  UAVs can be used to perform geophysical surveys, in particular geomagnetic surveys where the processed measurements of the Earth's differential magnetic field strength are used to calculate the nature of the underlying magnetic rock structure. Knowledge of the underlying rock structure helps trained geophysicists to

predict the location of mineral deposits. The production side of oil and gas exploration and production entails the monitoring of the integrity of oil and gas pipelines and related installations. For above-ground pipelines, this monitoring activity could be performed using digital cameras mounted on one or more UAVs.

- **Transportation:**

  UAVs can transport goods using various means based on the configuration of the UAV itself.

- **Scientific research:**

  Unmanned aircraft are especially useful in penetrating areas that may be too dangerous for manned aircraft. For example, fly into a hurricane and communicate near-real-time data directly to the data center.

- **Armed attacks:**

  The advantage of using an unmanned vehicle rather than a manned aircraft for USA in such cases is to avoid a diplomatic embarrassment should the aircraft be shot down and the pilots captured.

- **Search and rescue:**

  UAVs will likely play an increased role in search and rescue. Such as the search for missing persons and damage assessment...etc

- **Forest fire detection:**

  Another application of civil UAVs is the prevention and early detection of forest fires.

- **Future potential:**

  In the future, UAVs may be able to perform a variety of unique tasks apart from what they are capable of today. Engineers are currently working to produce remotely piloted UAVs that are

capable of air to air combat, aerial refueling, combat search and rescue with facial recognition, and resupply to agents on the ground.

2.3.2 Unmanned Ground Vehicles:

There are a wide variety of remote-operated UGVs in use today. Predominantly these vehicles are used to replace humans in hazardous situations. Examples are explosives and bomb disabling vehicles.

UGVs are also being developed for peacekeeping operations, ground surveillance, gatekeeper/checkpoint operations, urban street presence, and to enhance police and military raids in urban settings.

2.3.3 Remotely Operated Underwater Vehicles:

A remotely operated underwater vehicle, commonly referred to as an ROV, is a tethered underwater vehicle. They are common in deep water industries such as offshore hydrocarbon extraction.

2.3.4 Missiles:

In a modern military usage, a missile is a self-propelled guided weapon system, as opposed to an unguided self-propelled munitions, referred to as just a rocket. Missiles have four system components: targeting and/or guidance, flight system, engine, and warhead. Missiles come in types adapted for different purposes: surface-to-surface and air-to-surface missiles (ballistic, cruise, anti-ship, anti-tank, etc.), surface-to-air missiles (anti-aircraft and anti-ballistic), air-to-air missiles, and anti-satellite missiles. All known existing missiles are designed to be propelled during

powered flight by chemical reactions inside a rocket engine, jet engine, or other type of engine. Non-self-propelled airborne explosive devices are generally referred to as shells and usually have a shorter range than missiles.

2.4 UAV System Components:

UAV's are basically consist of the following elements:

- Unmanned Aircraft (UA).
- Ground Control system, such as Ground Control Station (GCS).
- Control link, 'communication and data link'.
- Other related support equipment.

This research will be focusing on studying and modeling of UAS's (Unmanned Air Systems).