Project Synopsis

Project Name: Drone

Project Member: Ashbey Gonsalves

Front End: HTML,CSS

Back End: ThingSpeak Cloud

OS Supported:

Hardware Requirements: Frame, Flight controller, Brushless motors, Electronic speed Controller (ESC), Battery, Propellers, Radio controller, antenna, GSM module, Power distribution board, Arduino uno/nano MQ2 gas sensor.

Description: Everyone knows what a drone does. It can go to places where humans can't go. This not just an ordinary drone it can help the firefighters to take a look in Emergency situations. If a factory has caught fire the drone can sense if there Are poisonous gases around it and can alert the firefighters to handle the Situation with care. This drone will consist of four powerful motors and their Speed will be controlled by the ESC. The power distribution board will Distribute power to flight controller which is the brain of the drone. The gas Sensor will detect the air quality and will alert the firefighters over a webserver Using internet. If the air quality goes down beyond a certain level, Means there Are amount of gases present in air like smoke, alcohol, CO_2, Methane, Propane and LPG. The gas sensor will be connected to Arduino and with the Help of GSM module it will be able to send message to the website. The drone Has goal which includes protect and save lives. Until recently, tools were Relatively low tech but now its changing with this new technology. With Increased urbanization, Traffic and new dangerous substance used in Construction the aerial drone technologies are helping to save lives.

Application areas: The drone can help to detect dangerous gases.

To detect underground poisonous gases.

Chapter 1:Introduction

1.1 Background :

These days harmful gas leakage is the main reason for industrial accidents and deaths of workers in industries. Pollutants released by industries into the atmosphere are also a cause for environmental pollution and such the reason greatly affects humans' and animals' health by minimizing the levels of oxygen and increasing the levels of harmful gases like alcohol, CO2, Methane, propane, and LPG. These gases are mainly the reason for increasing the number of pollutants in the atmosphere. These environmental pollution are mainly released by industries working with chemicals. Industry management only has an eye on profits and considers environmental safety as the least priority which in turn affects the atmosphere and industrial workers' health who are living in and around industries. Harmful gases are high around industrial areas compared to normal living places. As the population depends more on the usage of oil, gas, and coal for generating energy to meet the energy demand, the release of harmful pollutants increases day by day. It is observed that about 1.1 billion human population respiration is done through unhealthy air and recorded 7 million deaths occur globally. Industry owners are fully focused on the profit-oriented side of the business. They do not focus on the worker's safety as well as the health of the environment. Generally, industries are located outside cities, but some industries are located in the middle of the cities and villages because of the easy availability of transport and raw materials.

Due to human error or machine failures, gas leakage accidents occur often leading many workers into death beds. Gas leakage and detection of gas leakages and harmful gases in and around industries can effectively be handled by using sensors and automation using IoT. Here we developed a basic model for the detection of harmful gases and the measurement of harmful gases on a self-calibrated ppm scale and notifying the workers of the industry by SMS in case any gas leakage occurs in any sector of the industry.

It can also be used by firefighters in emergencies; it can alert the firefighters as soon as the gas is detected leading to faster response time.

1.2 Objectives :

The principal objective for the detection of gas releases should be to reduce the likelihood of fires and/or explosions and prevent excessive property damage, interruption to plant production, injury, and loss of life. An additional consideration is the toxicity hazard (ultimately the life hazard) created by a leak of a gas with both toxic and combustible properties.

Part of the overall design should include the procedures which address the actions to be taken by plant personnel when the gas detection system alarms. This should include what actions are to happen at the various alarm levels, actions to be taken in specific plant areas, and what effects the plant condition (shutdown, normal, upset) has on these actions.

This project aims to monitor hazardous environmental conditions, including toxic gases through a GSM modem.
This project can be used in industry or mines to monitor and help to warn people about toxic gas conditions.
This project can even be used as an air pollution detector. This is also called Remote Gas Monitoring systems.

Applications and Advantages:

1. Industry applications: Recently, a major gas leak happened in a plant near Visakhapatnam in LG Polymers chemical plant causing the death of at least 12 people and numerous cattle. One similar gas leak (in a paper mill in Raigarh, Chhattisgarh) and one boiler blast (Neyveli, Tamilnadu) followed. While these events were being investigated, on 22 May, Pune in Maharashtra saw a major fire break out in a chemical factory. These series of industrial accidents raised some questions. We need to understand why these unfortunate events keep happening? And how can they be stopped from recurring in future?

Harmful gas leakage accidents are the main reason for workers death in industries which work mainly using chemicals. Gas leakage can be easily detected using MQ2 sensor interfacing with an Arduino which in turn can alert the workers. Combustible gas detection systems are typically arranged to signal an alarm at two different levels of gas concentration. The system could activate output alarm devices and also signal that a specific level of combustible gas exists. Two common alarm set points are 20% LEL and 40% LEL. At 20% LEL the system activates a warning light at the panel and a local alarm in the area of the sensor causing the alarm. This could allow for evacuation of the area, increase in ventilation rate and/or an immediate check of the area by qualified personnel. At 40% LEL, the system provides another alarm light, expands the audible/ visual alarm beyond the local area, automatically shuts down and/or vents process equipment, activates vapor dispersion systems, and pages emergency personnel so that they could take appropriate action.
They can also use it to monitor the gases released by the industries to check whether they are safe for the environment.

2. In the coal mines: Spontaneous combustion of coal seam has been and continues to be a big problem in coal mines. Carbon monoxide is typically the main component of noxious gases that leak from coal deposits, and they must be dispersed before poisoning miners or exploding. But coal mines have large areas and it can be a real challenge for the workers to check if there is any leakage in any area. By flying this drone around the area, the workers will be able to know if there is any leakage in the mine. In case of any leakage of gas, the drone will alert the workers before the situation turns into a disaster.

3.Fire extinguishing: This drone can be useful in emergencies such as the Chernobyl incident where about a quarter of the casualties were not from radiation but from the toxic gases which were released during the explosion. If this drone was deployed in the area before the firefighters, they could have been sent in with proper equipment to nullify the effects of the gases.

4.Forest fires: Nowadays, forest fires often cause serious threats to the environment and produce real emergencies and natural disasters.
The response time of emergency corps greatly affects the consequences and losses caused by them, so the enhancement of forest fire prevention and detection systems can be considered the main goal for conserving the environment.
Concerning this, the real-time monitoring of certain environmental variables may make forest fire prevention, detection, and fighting more efficient.
This drone fills exactly that gap of monitoring the forests in real-time to notify the firefighters to lessen the response time as well as notify the residents of that area to evacuate.

1.3 Purpose and scope

1.3.1 Purpose :

Daily around the world, humanity faces many deaths due to suffocation or loss of consciousness where a human doesn't even realize that his oxygen levels are dropping. This project has been created to try to prevent such an event from happening. The system comprises a drone with an Arduino and a specific gas sensor to detect harmful gases.

During an emergency, before the respective personnel arrives onto the site, they can deploy this drone and search for any gases present in the areas as well as compute the percentage value of the gases. The sensor is attached to an Arduino Uno R3 which detects the changes in voltage from the analog gas sensor and in turn computes the percentage and the nature of the gas(whether it is harmful or not). If the gas is harmful, the GSM module attached to the Arduino will send a message via SMS to a handset. The GSM module has an inbuilt accelerometer and a gyroscope that assists the drone in sending the coordinates along with the message.

This drone can prevent many disasters from happening. A small mistake can cause a great disaster. It also can be used by NGOs to keep track of factories that emit poisonous gases and don't care about the environment. The drone has 4 powerful motors that are connected to an Electronic speed controller(ESC). They can carry the Arduino along with the sensor. It can fly up to 800 m and can be further upgraded with a camera and obstacle avoidance sensor. Therefore, from this project, we can save lives and prevent multiple disasters from occurring.

1.3.2 Scope:-

In this project, a clever framework is developed for toxic gas and radiation discovery, to defeat the drawback in more established techniques by utilizing the GSM module and the web of things. Consequently, the utilization of serial correspondence makes the framework with the Arduino controller and IoT. This project can be further developed by adding a microcomputer such as Raspberry Pi with a camera for image processing. It can also be upgraded by adding an obstacle avoidance sensor and neural networks to make it autonomous. This can be combined together with a cloud server to make a full-fledged system.

Such types of drones is the future of technologies which will help mankind with risky operations thereby preventing disasters or loss of human lives.

Chapter 2: System Analysis

2.1 Existing System

Companies like DJI, Yuneec, Hubsan, Parrot are far more ahead with drone technology. The drones made by these companies are excellent no doubt they are big enough and much more stable. These companies make the consumers/companies easy to purchase their choice of the drone at a high selling price. The drones manufactured by these companies are yet to come up with gas sensing technology. Until now many lives have been lost due to gases leaked in industries also in coal mines due to poisonous gases emitted. It can cause a massive disaster and there will be a loss of human lives.

This technology can avoid many disasters from happening. The drone can be easily operated by an individual who is not trained and can get the data of the gases on the web application. There will be no human loss in this process the person who is operating the drone can control it at a safe distance (1KM). This technology is good enough to detect gases without anyone having to get on to the site. In India, there is no such technology used, this drone also can help the firefighters to handle the situation with care and can warn them about poisonous gases well in advance.

With this technology you can avoid these following things:
1.Risk of life.
2.Can approach the situation calmly and with efficiency.
3.More flexible and can pass through small areas.
4.Provides more vision and information.

2.2 Proposed system

With gas emissions coming under ever closer environmental scrutiny, as well as the more immediate safety issues that can result from gas leaks across a variety of fields, it’s no surprise to see the drone industry step up with solutions designed to minimize risk and maximize efficiency. With such products, identifying threats would be much easier than sending in humans. The gas sensor on the drone connected to Arduino can sense the gases and can send the data to the web application.

The drone has 4 powerful motors that are connected to the flight controller can carry the gas sensor to detect gases operated by an individual. An aerial solution can also be of great benefit to emergency responders or firefighters, who might want an immediate overview of an incident, be it a warehouse fire or a chemical spill. These are all places where you wouldn’t happily want to place a human being due to the potential risks of inhalation and even of an explosion – and so having an aerial ally who can give you a quick and real-time evaluation of any gas detection scenario before you send in a ground team can make a huge difference.

There are some obvious use case examples, including those working on gas plants (or gas-powered plants) and pipelines, or other sites that require gas storage of all shapes and sizes. Considering the range of gases used in industrial and commercial applications there will be plenty more companies operating with at least one variant, if not several. Not only could a leak prove a very serious health hazard, but it can also be very costly, with thousands of pounds vanishing into thin air.

Removing the human factor from any potentially dangerous situation is a major plus. Being able to remain anywhere from 100 meters to several miles away significantly reduces any risk to those involved. Gas emissions coming under ever closer environmental scrutiny, as well as the more immediate safety issues that can result from gas leaks across a variety of fields, it's no surprise to see the drone industry step up with solutions designed to minimize risk and maximize efficiency.

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It's also worth bearing in mind that many gases are lighter than air, meaning that in an indoor environment the gas will rise and be thicker nearer the ceiling. This could mean that a ground-based crew is not getting the most accurate results, while a drone can cover every corner without the need for scaffolding, cherry pickers, or other support – and all while maintaining 360-degree awareness of its surroundings. Indeed, as with inspections and surveying, having a tool that can easily navigate in and around dangerous or otherwise inaccessible places is always one of the main benefits of any aerial solution. An aerial solution can also be of great benefit to emergency responders or firefighters, who might want an immediate overview of an incident, be it a warehouse fire or a chemical spill.

These are all places where you wouldn't happily want to place a human being due to the potential risks of inhalation and even of an explosion – and so having an aerial ally who can give you a quick and real-time evaluation of any gas detection scenario before you send in a ground team can make a huge difference.

2.3 Requirement Analysis

By Introducing this technology it is important to know whether there is a need for that advancement or not. Also, it is necessary to know what the consumer expects from the product.

66.7% of people agreed that there is a need for introducing a gas-sensing drone technology in the market. Only 33.3% disagreed that there is no need for such technology to introduce. 100% of people agreed that this technology will be helpful for firefighters as this technology can be very useful for saving lives. 66.7% agreed that this technology will be useful for personnel use. 33.3% disagreed on this that no such technology will be useful for personal use. 66.7% agreed that a Stationary interconnected grid of sensors and gas sensing cars will be an alternative solution for this project.

According to the price section, most people selected between 10k to 15k should be the price of this drone in the market. 100% agreed that many lives can be saved using this technology as this drone is meant for saving lives. 100% agreed that this concept will be helpful in the future. As the gas sensing drone concept is useful and helpful for most people. A stationary interconnected grid of sensors and the FPV system will help the drone to be more cautious about the situation. The overall feedback about the project is excellent for most people. As 100% of people agreed that this technology will be useful for firefighters and to save prevent disasters from happening is the main motive of this technology. 66.7% agreed that this can be a reliable source of information about the situation and 33.3% disagreed on this concept.

The people who agreed on this project gave many suggestions that the drone can be upgraded with the first person system(FPV). This system consists of a camera attached to the drone the person who is controlling the drone will have to wear the Fpv frame through which he can get connected to the camera on the drone will be easy to handle. He will get a clear view of the drone and will be easy to control without losing it. According to some people adding a GPS in it will be useful too. If the situation is more complicated and the drone has to go further out of the controller’s vision it has the chances that the drone can get lost. So to avoid this few of the people suggested adding a GPS to avoid this accident. By adding all these features the drone can be more useful to people.

The overall feedback about the people on this project was good enough. Building this kind of technology will be very useful in the future. Human lives can be saved through such technology. This technology can also further be useful to avoid big disasters to happen.

2.4 Hardware Requirements

1.Frame
2.Flight controller
3.Brushless motors
4.Electronic speed controller(ESC)
5.Battery
6.Propellers
7.Radio controller
8.Antenna
9.GSM module
10.Power distribution board
11.Arduino Uno/Nano
12.MQ2 gas sensor

The flight controller can be described as the brain of the drone. There will be four brushless motors controlled by an electronic speed controller(ESC) that is connected to the power distribution board. The GSM module and the gas sensor will be connected to an Arduino. A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The MQ2 gas sensor will help to detect gases.

2.5 Software requirements

1.Arduino IDE
2.SQlite database/Thingspeak cloud
3.HTML,CSS

Arduino is an open-source electronics platform based on easy-to-use hardware and software. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. SQLite is a C-language library that implements a small, fast, self-contained, high-reliability, full-featured, SQL database engine. SQLite is the most used database engine in the world. HTML and CSS can be used in the front-end for making the website which will be used for displaying the information.

2.6 Justification for the selection of technology

\Removing the human factor from any potentially dangerous situation is a major plus. Being able to remain anywhere from 100 meters to several miles away significantly reduces any risk to those involved. Traditional methods might include a person being kitted up in a large, hot, and heavy suit, typically equipped with a limited air tank, who'll use a handheld sensor that requires them to get very close to the source. The main motive of this technology is no human should be harmed during such an incident.

Hundreds of miners die due to accidents in the mines per year in IndiaBelow are the five horrific mining accidents which killed hundreds of miners in India.

Chinakuri Colliery disaster
The explosion at the Chinakuri Colliery (coal mine) occurred on February 19 in 1958 killed 182 people.

Dhanbad coal mine disaster
The explosion which occurred on May 28 in 1965 at Dhanbad Coal Mine was so fierce that it killed 268.

Introducing such kind of technology can prevent such kind of incidents to happen in India. An aerial solution can also be of great benefit to emergency responders or firefighters, who might want an immediate overview of an incident, be it a warehouse fire or a chemical spill. These are all places where you wouldn't happily want to place a human being due to the potential risks of inhalation and even of an explosion and so having an aerial ally who can give you a quick and real-time evaluation of any gas detection scenario before you send in a ground team can make a huge difference.

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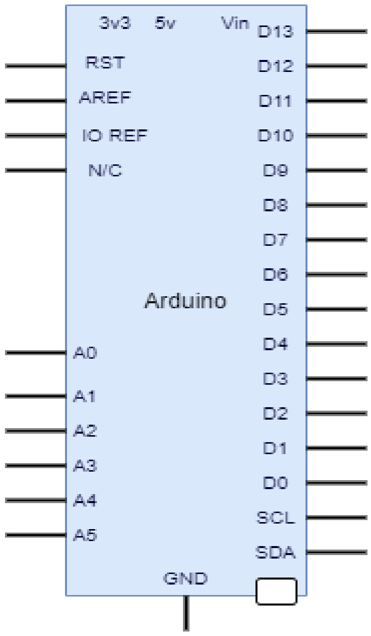
The future is of drones because they do the work which a human being cant do without time being wasted and the most important thing that many lives are saved by using this technology.

Chapter 3: System Design

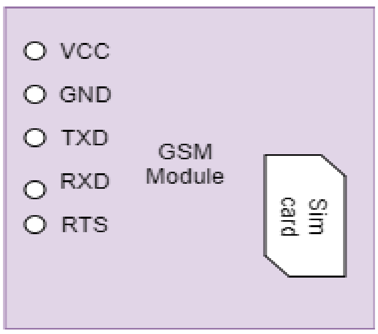
3.1 Module design

Fig 3.1.1



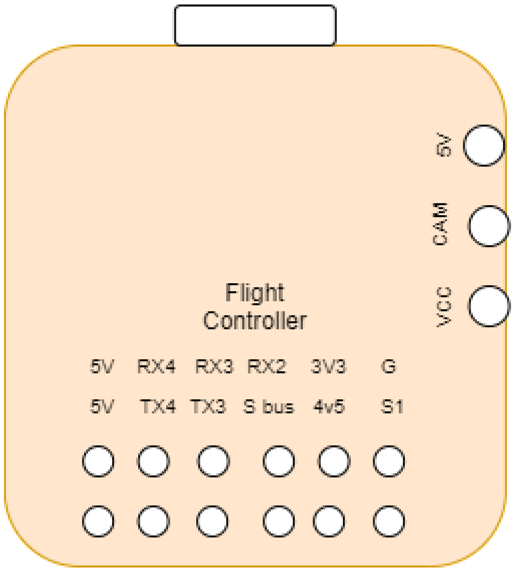
ARDUINO

Fig 3.1.2



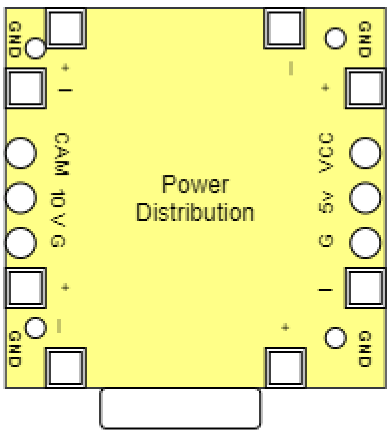
GSM
MODULE

Fig 3.1.3



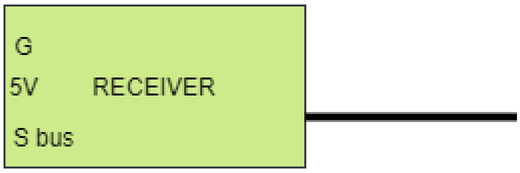
FLIGHT
CONTROLLER

Fig 3.1.4



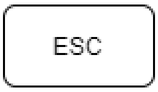
POWER
DISTRIBUTION

Fig 3.1.5



RECEIVER

Fig 3.1.6

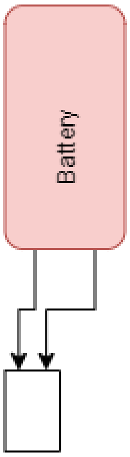


ELECTRONIC
SPEED
CONTROLLER

Fig 3.1.7

MOTORS

Fig 3.1.8



BATTERY

Fig 3.1.9

GAS
SENSOR

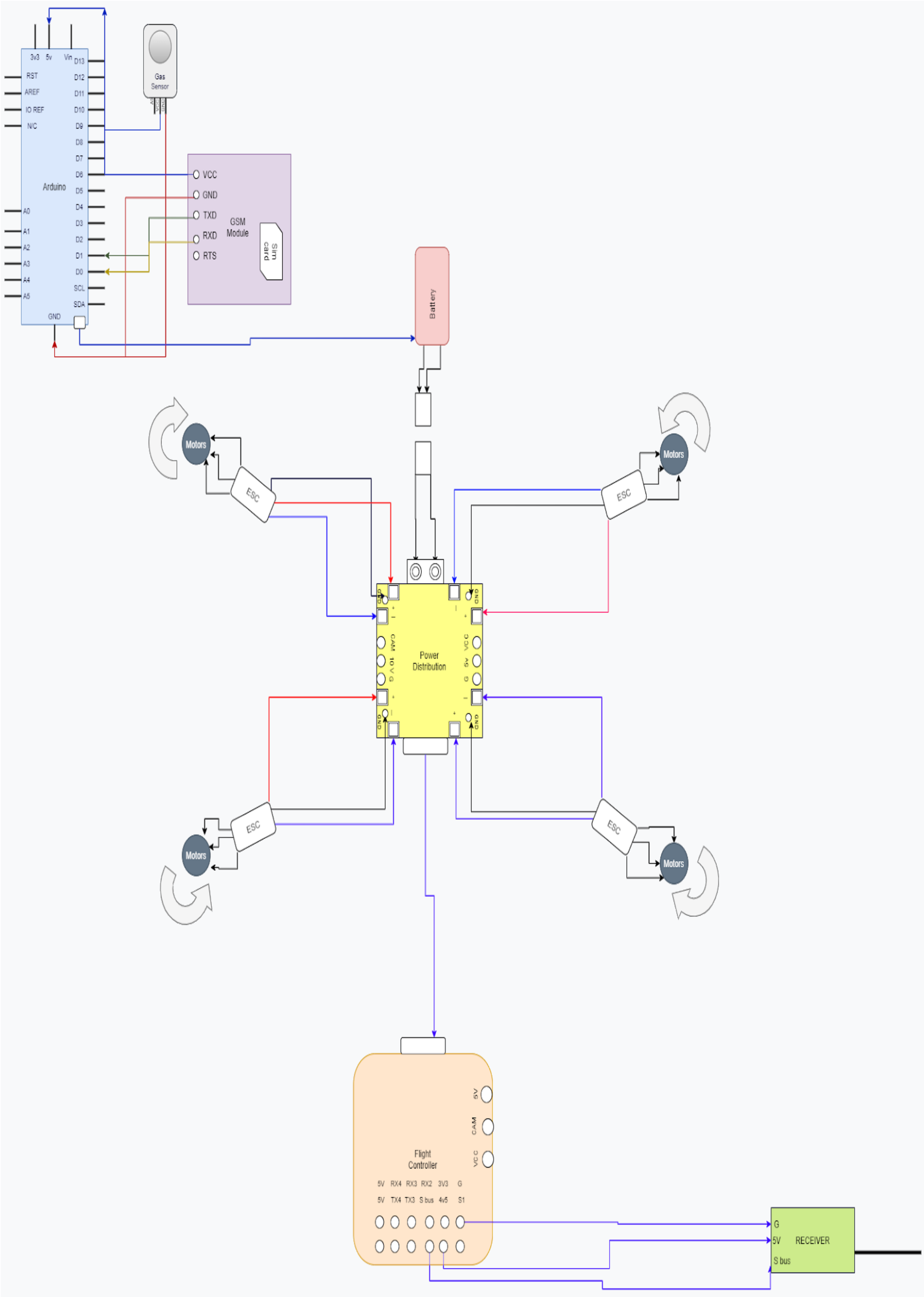

3v3
5v
Vin
RST
AREF
IO REF
N/C
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
SCL
SDA
A0
A1
A2
A3
A4
A5
GND
Arduino
Gas Sensor
VCC
GND
TXD
RXD
RTS
GSM Module
Sim card
Battery
Motors
ESC
Power Distribution
CAM
VCC
GND
Flight Controller
5V
CAM
VCC
5V RX4 RX3 RX2 3V3 G
5V TX4 TX3 S bus 4v5 S1
G
5V
S bus
RECEIVER

Fig 3.1.10

Interface:

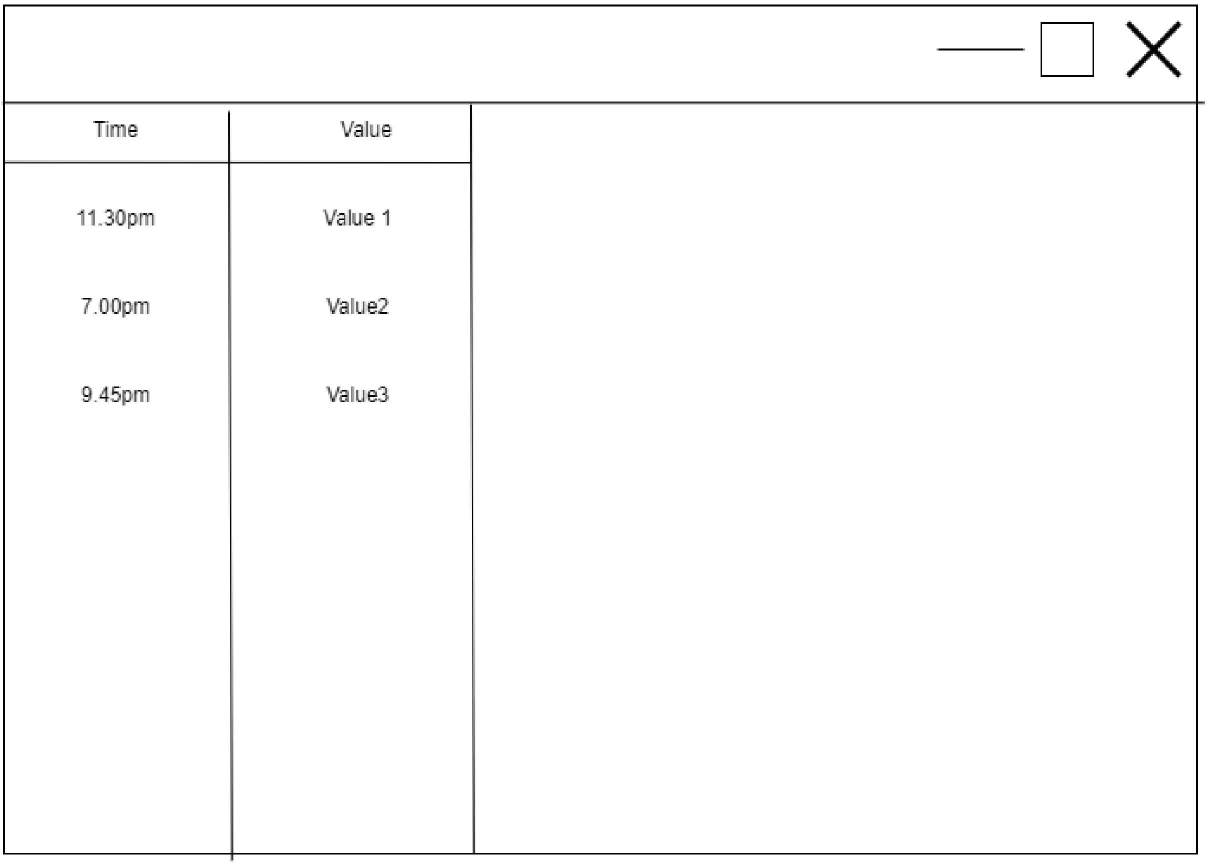


Fig 3.1.11

3.2 Data dictionary:

Abbreviations	Full Forms
D0-D13	Digital pins
A0-A5	Analog pins
GND	Ground pins
5v	5-volt power supply pin
3v3	3.3-volt power supply pin
10v	10-volt power supply
4v5	4.5-volt power supply
VIN	5-volt power in pin
SCL	Serial clock pin
SDA	Serial data pin
VCC	Voltage common collector
TXD	Transmit data
RXD	Receive data
RTS	Request to send
CAM	Camera
S bus	Smart bus
S1	Serial pin

Table 3.2.1

3.3 UML Diagrams:

3.3.1 Use Case diagram

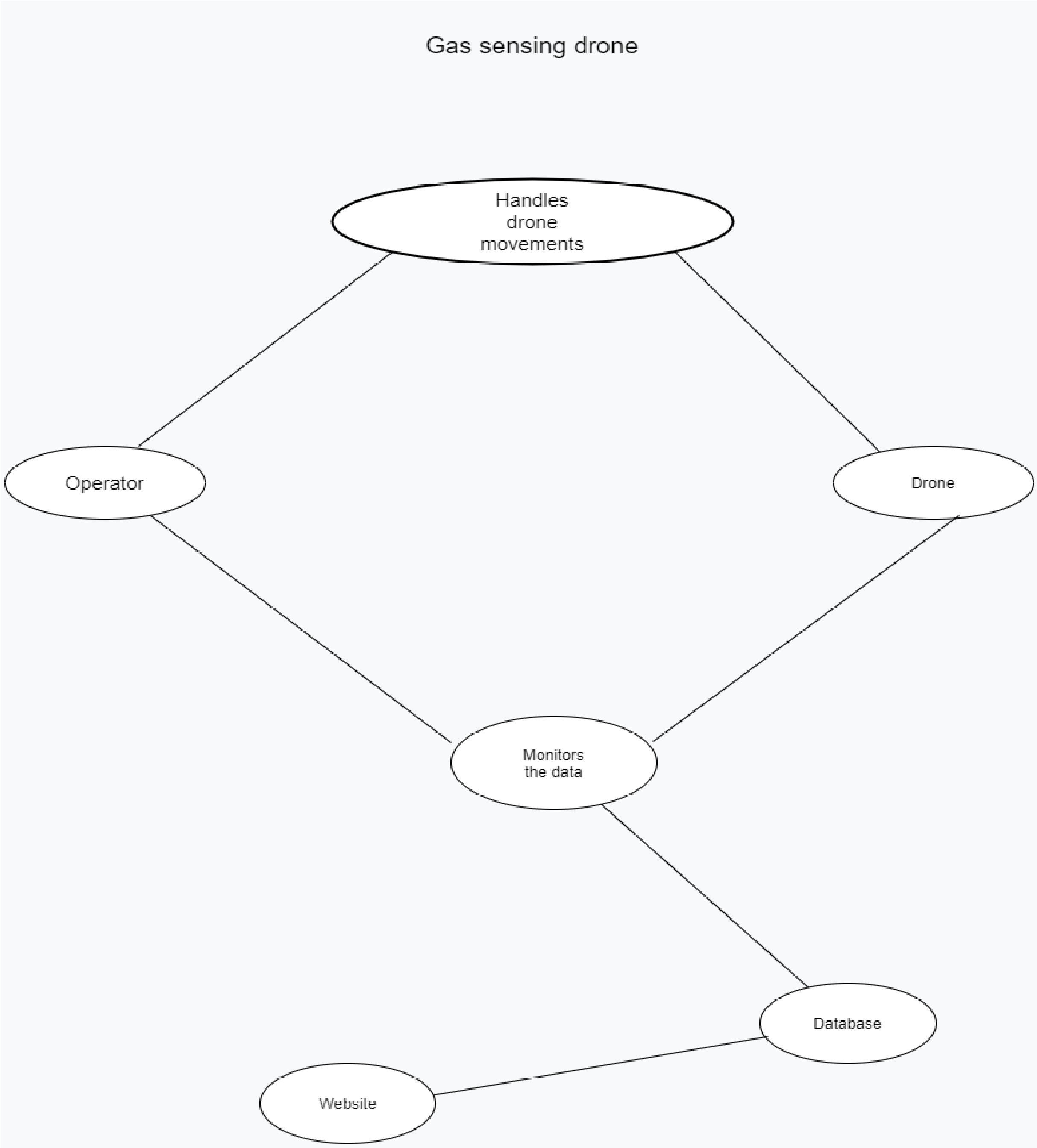


Fig 3.11

3.3.2 Class diagram

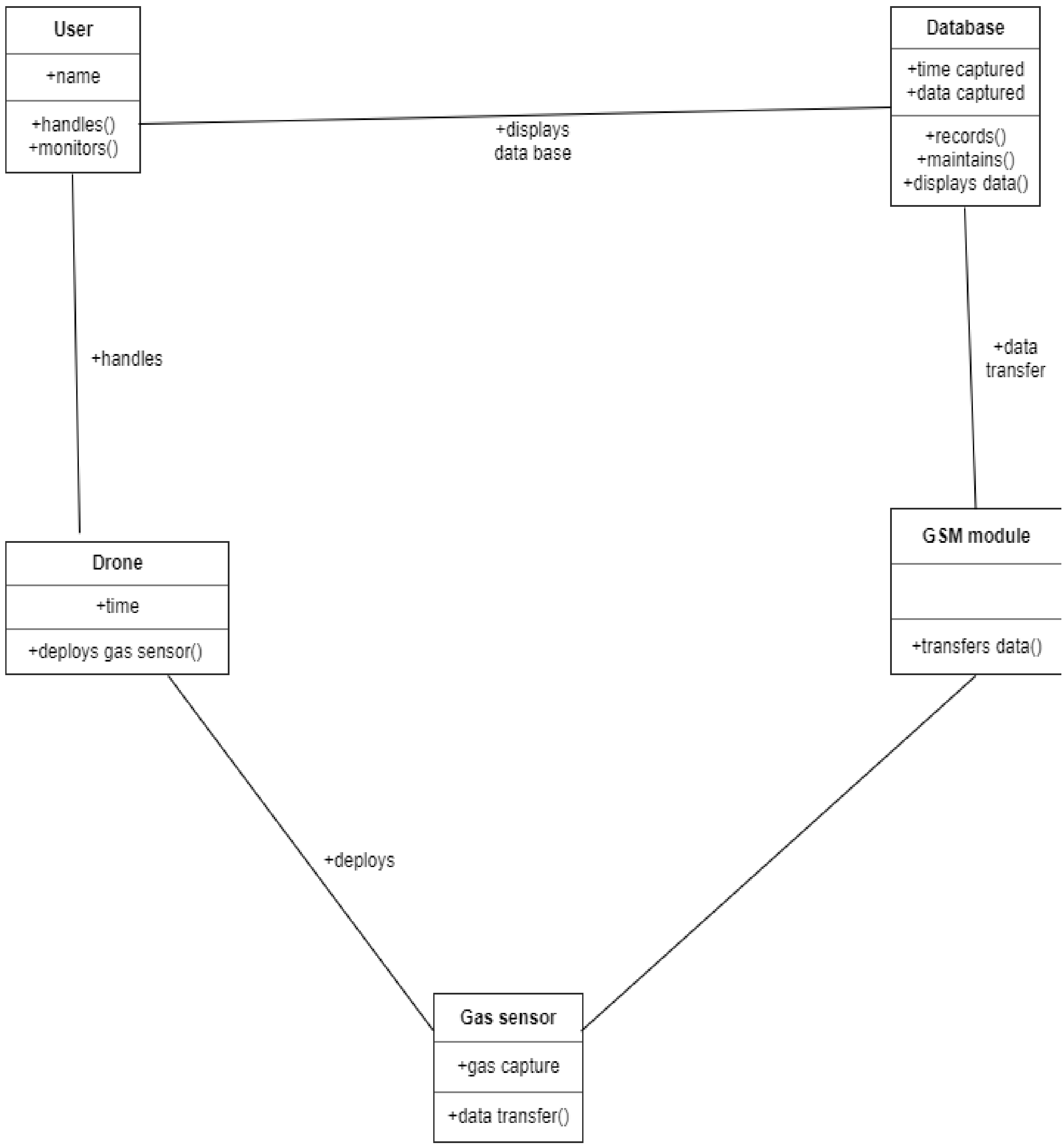
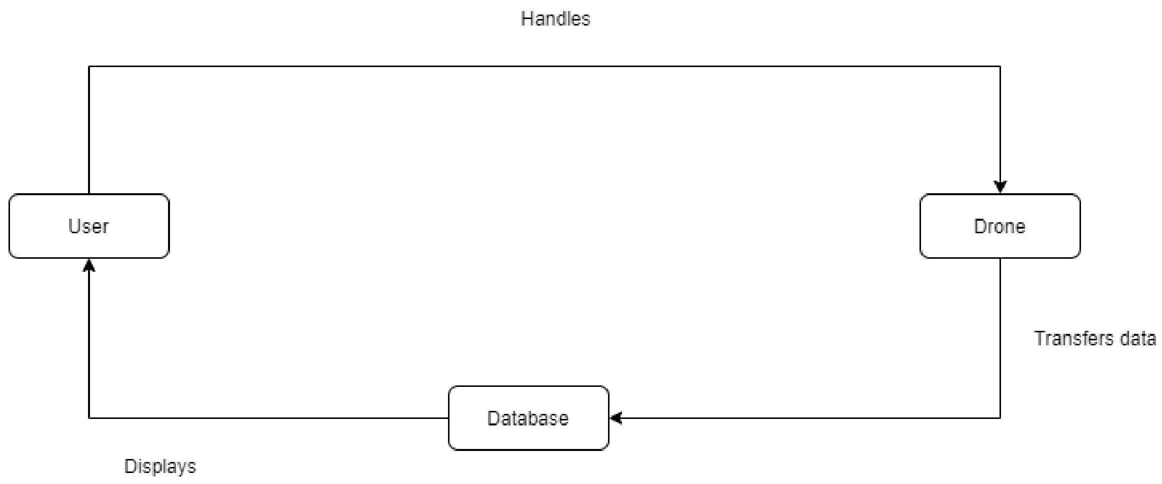


Fig 3.12

3.3.3 Data flow diagram



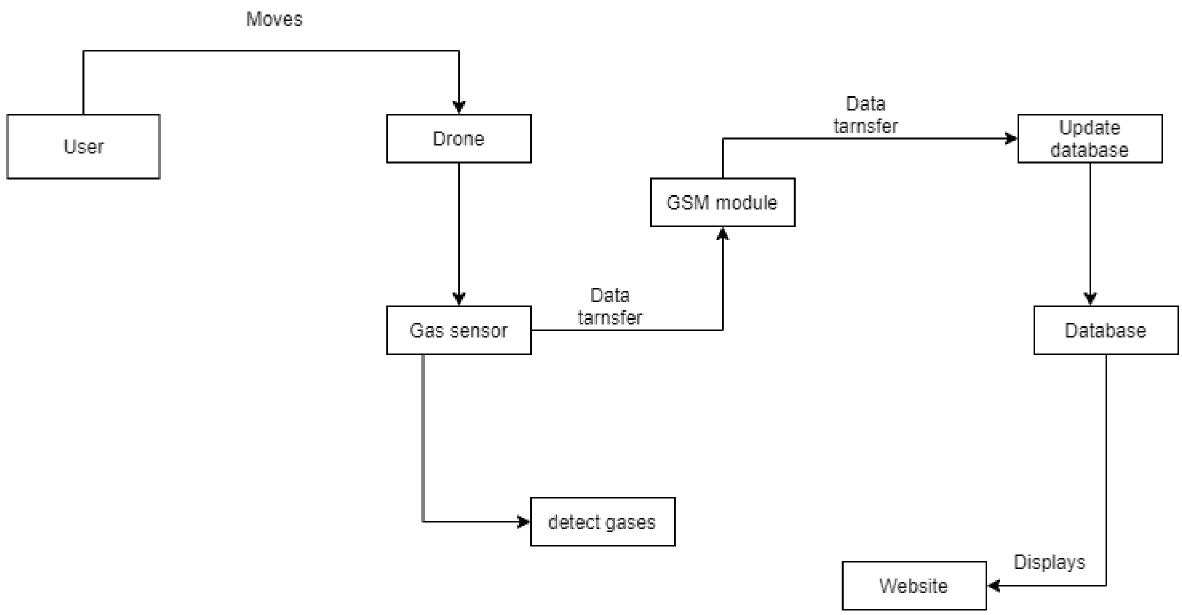


Fig 3.13

3.3.4 Activity Diagram

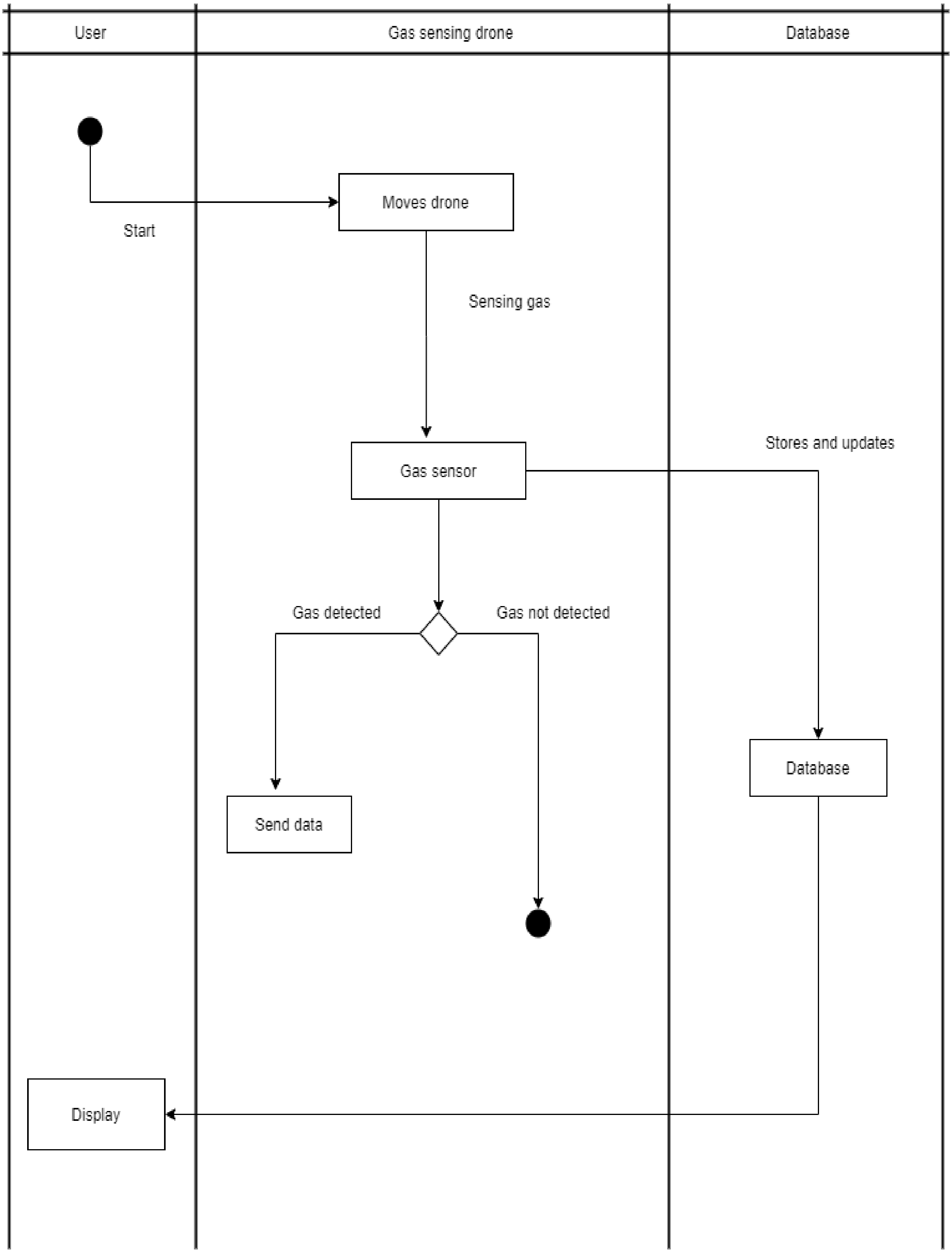


Fig 3.14

3.3.5 Sequence Diagram

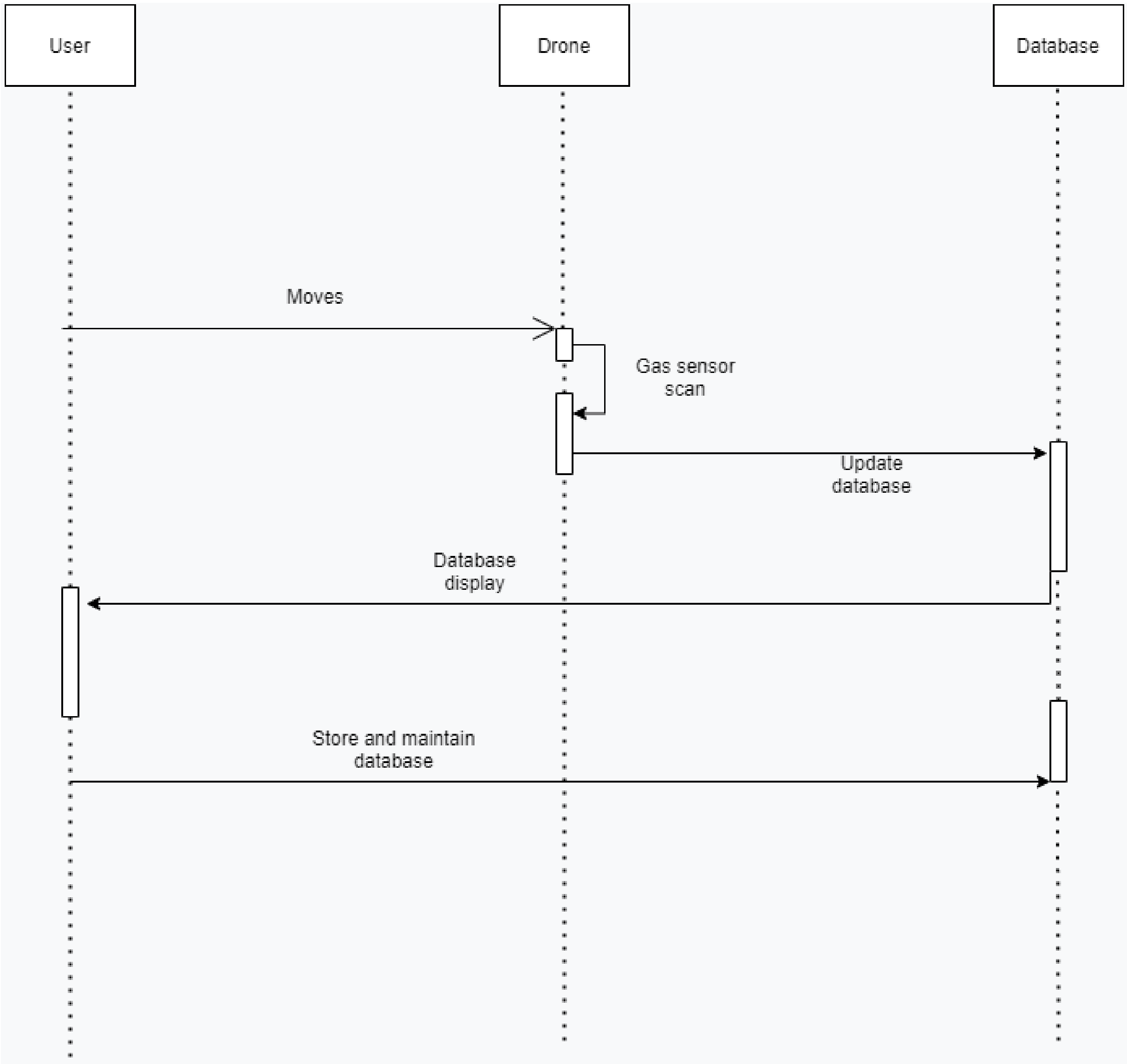


Fig 3.15

3.3.6 Object Diagram

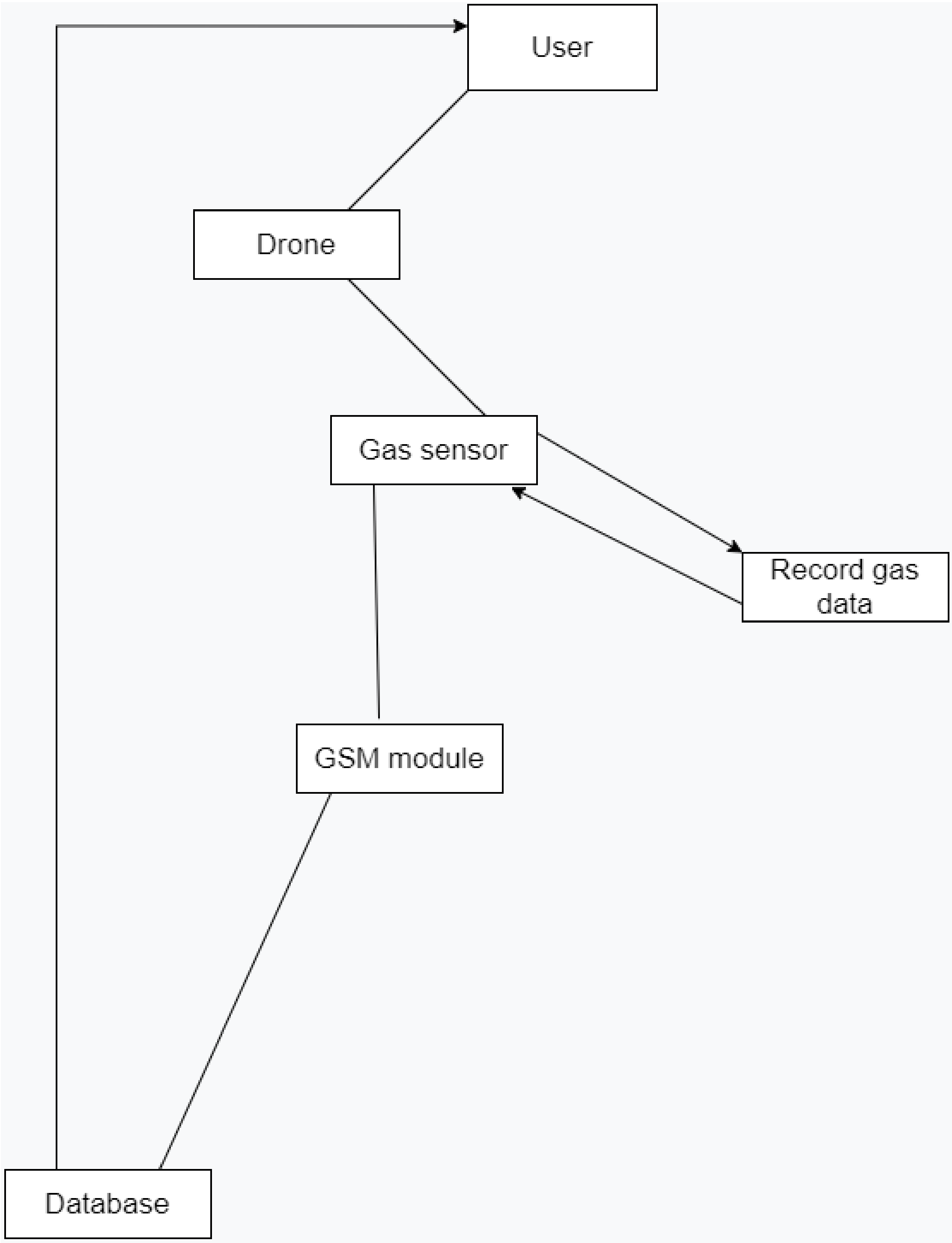


Fig 3.16

3.3.7 State Diagram

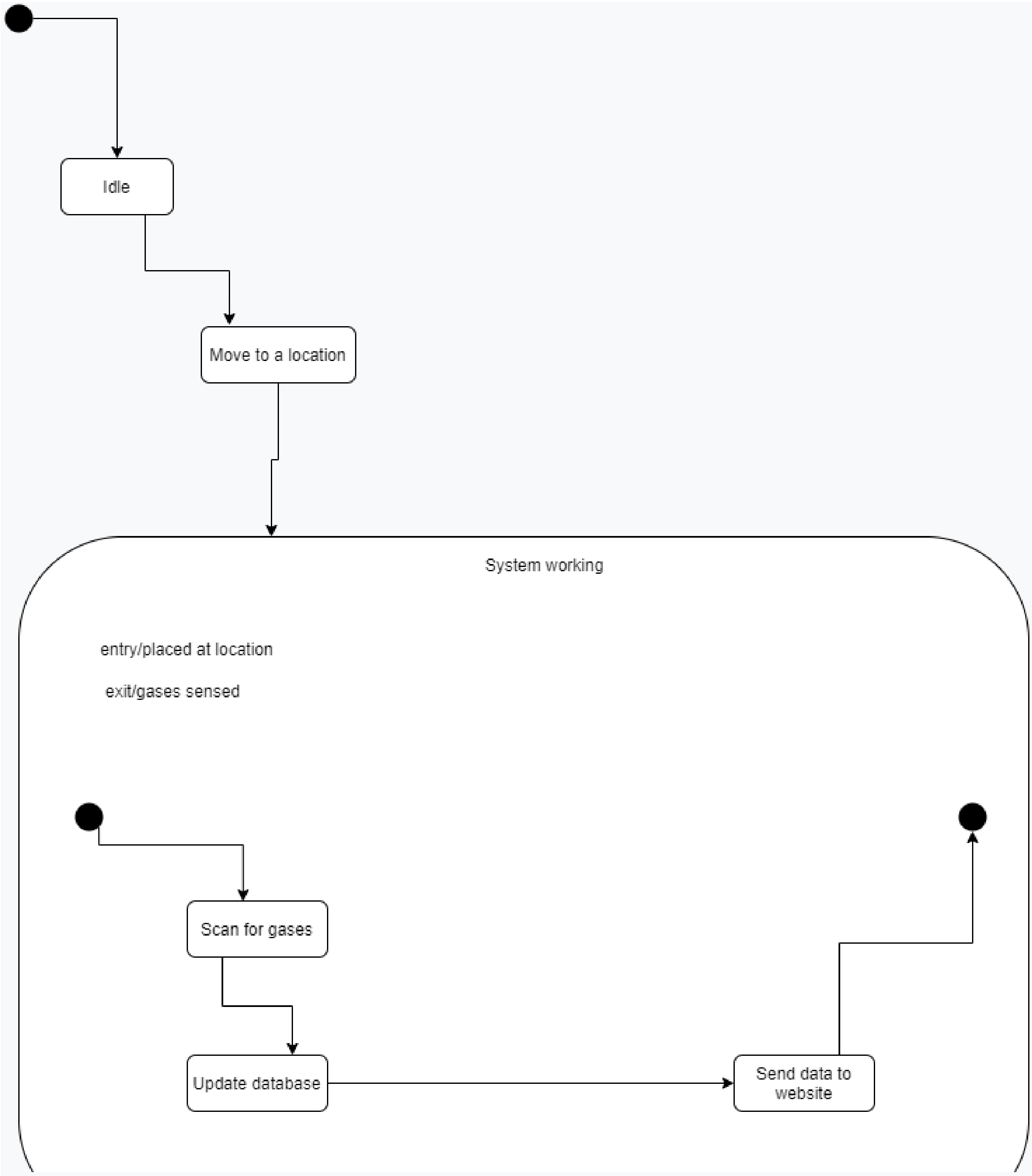


Fig 3.17

3.3.8 Component Diagram

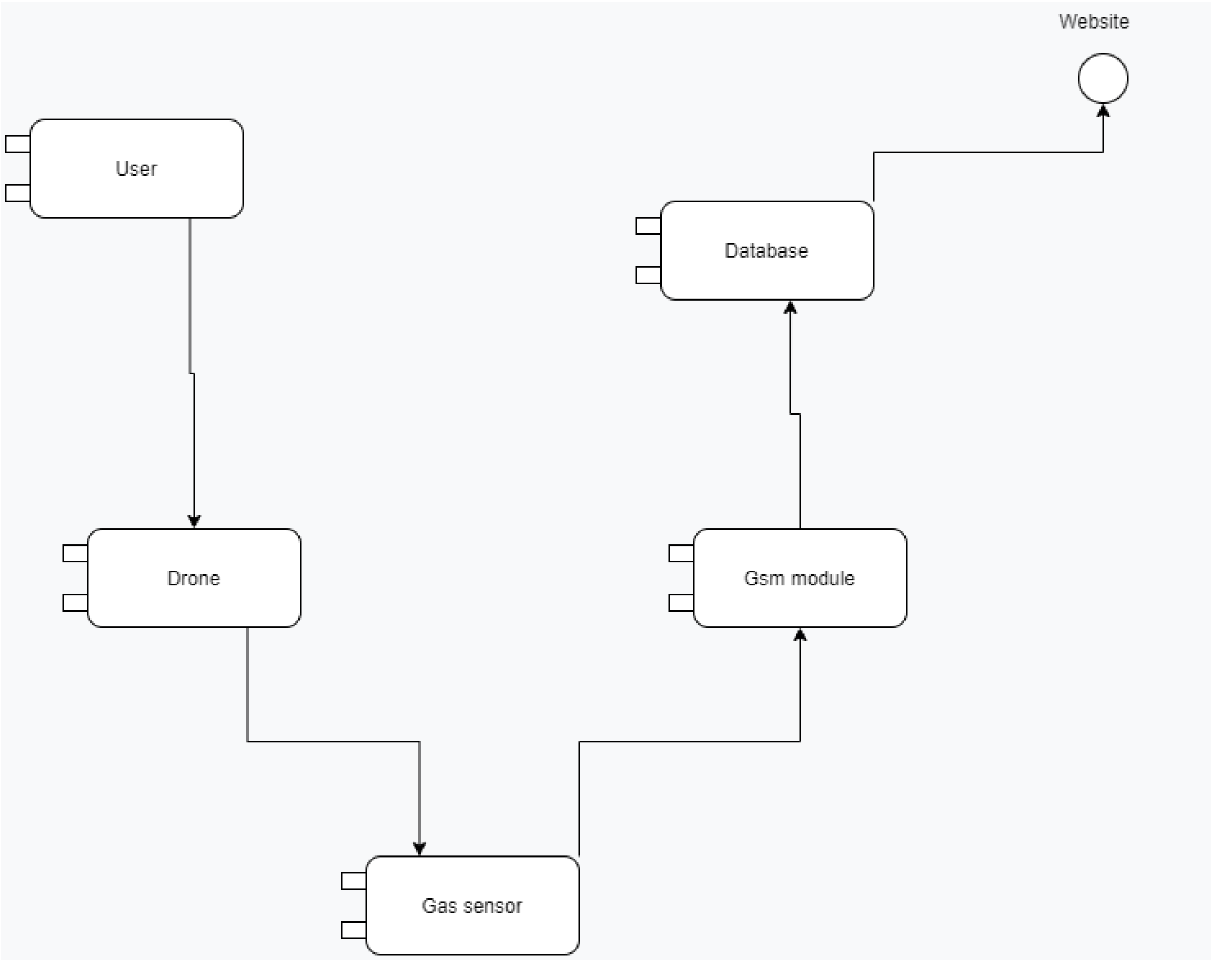


Fig 3.18

3.3.9 Deployment Diagram

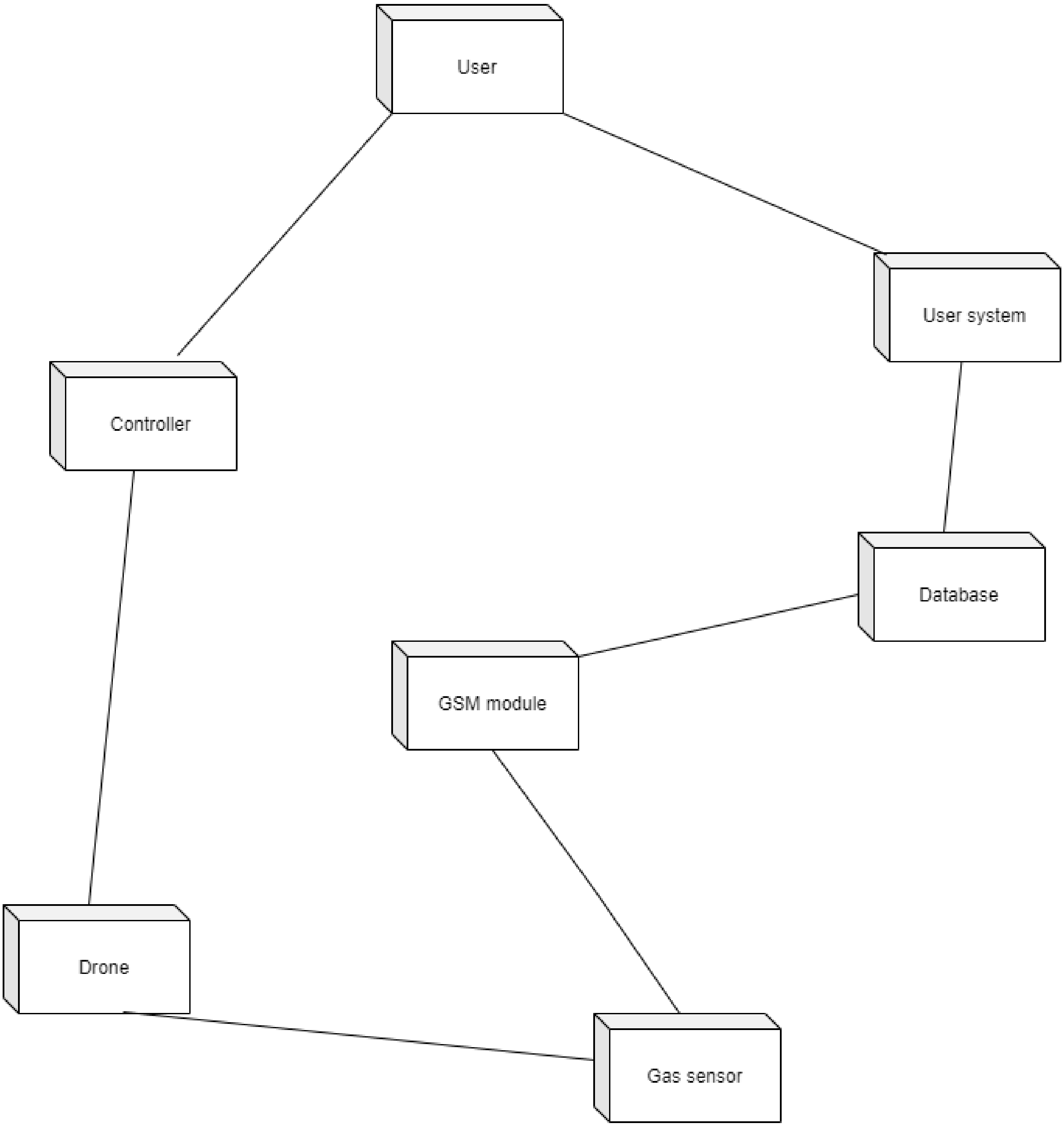


Fig 3.19

3.3.10 Collaboration Diagram

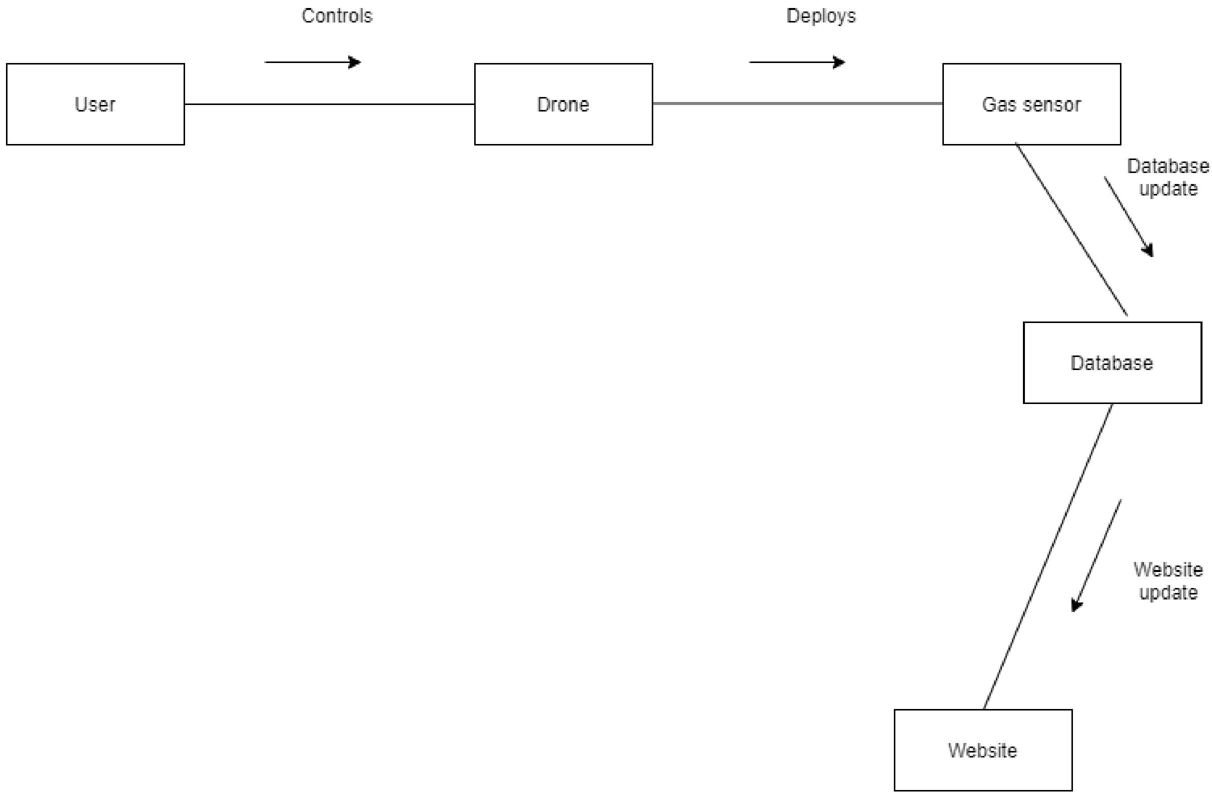


Fig 3.20

Chapter 4: Implementation and testing

4.1 Test case

4.1.1 Test case 1:

Test case ID: Move1
Test case Name: Move forward.
Test case description: This test is conducted to check if the drone moves forward.
Pre-condition: The drone is stable in one place.
Input: Control stick pushed forward.
Actual output: Drone moves forward.
Expected output: Drone moves forward.

4.1.2 Test case 2:

Test case ID: Move2
Test case Name: Move backward.
Test case description: This test is conducted to check if the drone moves backward.
Pre-condition: The drone is stable in one place.
Input: Control stick pushed backward.
Actual output: Drone moves backward.
Expected output: Drone moves backward.

4.1.3 Test case 3:

Test case ID: Move3
Test case Name: Turn right.
Test case description: This test is conducted to check if the drone turns right or not.
Pre-condition: The drone is stable in one place.
Input: Control stick pushed to the right side.
Actual output: Drone turns right.
Expected output: Drone turns right.

4.1.4 Test case 4:

Test case ID: Move4
Test case Name: Turn left.
Test case description: This test is conducted to check if the drone turns left or not.
Pre-condition: The drone is stable in one place.
Input: Control stick pushed to the left side.
Actual output: Drone turns left.
Expected output: Drone turns left.

4.1.5 Test case 5:

Test case ID: Upwards 5

Test case Name: Goes up.

Test case description: This test is conducted to check if the drone goes upwards.

Pre-condition: The drone is stable in one place.

Input: Control stick pushed upwards.

Actual output: The drone goes up.

Expected output: The drone goes up.

4.1.6 Test case 6:

Test case ID: Downwards 6.

Test case Name: Goes down.

Test case description: This test is conducted to check whether the drone goes downwards.

Pre-condition: The drone is mid-air.

Input: Control stick pushed downwards.

Actual output: The drone goes up.

Expected output: The drone goes down.

Remarks: Test failed.

4.1.7 Test case 7:

Test case ID: Gas test 7

Test case Name: Gas test

Test case description: This test is conducted to check whether the gas sensor functions correctly.

Pre-condition: No gas present.

Input: Gas is present in the air.

Actual output: Gas is not detected.

Expected output: Gas is detected by the sensor.

Remarks: Test failed.

4.1.8 Test case 8:

Test case ID: Gassensed 8.

Test case Name: Gas sensed test.

Test case description: This test conducted to check whether the information is visible on the website.

Pre-condition: Gas being sensed.

Input: Gas being sensed by the drone.

Actual output: No information about gases is on the website.

Expected output: Information about gases displayed on the website.

Remarks: Test failed.

4.1.9 Test case 9:

Test case ID: Connect2

Test case Name: Wi-Fi connectivity.

Test case description: This test checks the Wi-Fi connectivity.

Pre-condition: No signal from the drone.

Input: Gas created in front of the drone.

Actual output: The host system receives a signal from the drone about the flame.

Expected output: The host system receives a signal from the drone about the flame.

4.1.10 Test case 10:

Test case ID: Battery10.

Test case Name: Battery connection.

Test case description: This test conducted to check whether the battery is connected to the drone.

Pre-condition: No signal from the drone.

Input: Battery plugged in.

Actual output: The lights turn on.

Expected output: The lights turn on.