SMART DRONE FIRE EXTINGUISHER

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Abstract: In world where fire accidents are increases commonly and the first responders always risk their lives to save the lives of others. Unfortunately, history tells that these first responders do not survive most of the time. To save as many lives as possible, it is important to leave dangerous tasks to machines. One such device is a drone it provides great mobility and doesn't risk any personnel. Drones can also gather information through the Flame sensor the GSM detects the exact location of fire with the help of temperature sensor at greater speed and Arduino-UNO is helps for communication and also drones are having great mobility. has 360 degree view, reliability.

I. INTRODUCTION

Currently, there is a lack of unmanned aerial vehicles that are being used with the purpose of extinguish a fire or help prevent one. An unmanned aerial vehicle (UAV) is an aircraft without a human pilot on board. Its flight can be controlled autonomously by computers in the vehicle, or by remote control under the direct command of a human. In the United States and the rest of the world, most of the UAVs in existence are being used for the defense purpose. Fires that occur in homes and nonresidential buildings as well as fires in wild lands cause plenty of health issues; including death to humans and animals, in addition to great economic losses in structures, equipment and vegetation. Furthermore, the first response teams, such as firefighters, are exposing their lives to great risks in order to extinguish a fire. In addition to those huge problems, there is another one that does not cause so many struggles, but it does have a negative effect when a fire occurs. One of the most popular ways to extinguish fires is to spray water in the area affected by the flames. The water can be delivered via hose using a pressurized fire hydrant, fire sprinkler system, pumped from water sources, such as lakes, rivers or tanker trucks, or dropped from aircrafts in the case of wild land fires. In this project we will combine these two ideas of morphological drone and fire fighter drone to create a working morphological fire fighter drone. Fire fighter drone will be operating high temperature environments, so designing should be done by keep that in mind. By the implementation of the morphing technology to the Fire fighter drone efficiency of the system can be improved. By the addition of the system Fire fighter drone will able to reach places where it cannot reach earlier and operation Fire fighter drone will more easily in closed building. Our system makes use of 4 x Drone motors coupled with a drone frame controlled by a flight controller to operate the drone in a stable condition. We now use a long range rf remote and receiver pair for transmitting drone control commands to the drone. Also the drone is equipped with a small drone camera for live footage viewing by the user. of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

II. OBJECTIVES

- To Design Fire Fighting Drone technology to save life.
- To extinguish the fire through the nozzle in an area that is difficult to approach by conventional methods like narrow passages and indoors.
- Through the camera it detects exact location of fire and it has 360 degree view.
- This design project is to improve the ways in which fires are extinguished.

III. METHODOLOGY

The connection are made to the drone to work as fire extinguisher, the nozzle is directly connected to the drone to spray water through the pipe, the pipe is connected to water pump to the nozzle, the water pump is power with the lead acid battery the pump in let dipped in the water container outlet connected to nozzle.
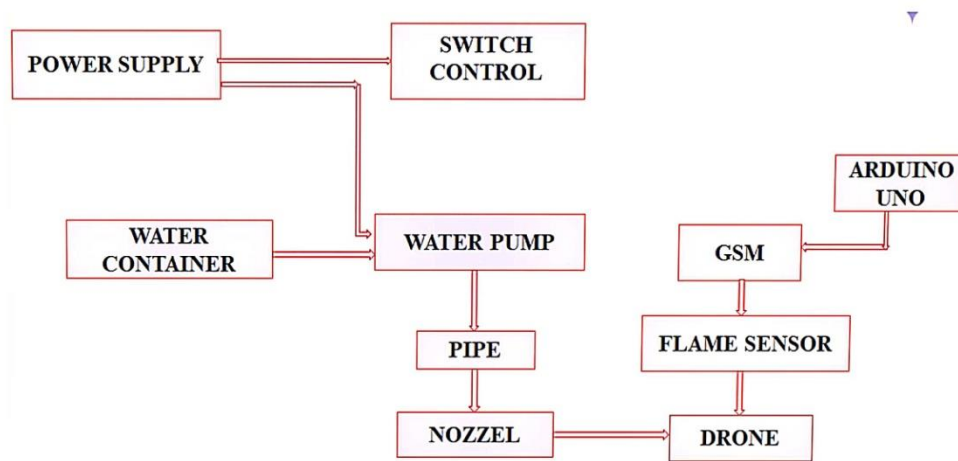
FIG 3.1 : BLOCK DIAGRAM

The fire detection is made through the temperature sensor which is mounted on the drone it is connected to the GSM through the arduino, if the fire is detected through the temperature sensor the GSM will make a call to the number which is provided in the code .the code is dumped to the arduino to make a alert call or alert text if the fire is detected, the arduino and GSM is powerd with battery. The water pump switch is on manually once after getting alert a call Then water pump is pump the water to the nozzle which is attached to the drone nozzle is spray the water to the fire place the fire is extinguished.

IV.   LITERATURE SURVEY

[1]. On a normal worki

ng day, fire fighters have to perform different activities from maintenance to conducting pre-incident planning or even cleaning and organizing. When an emergency occurs, fire fighters need to make critical decisions which are dependent on a number of factors such as the capabilities of the existing resources, the context of the emergency and the way the emergency is being comprehended based on the available information. Therefore, having live information about an incident (casualties, spread of fire etc.) is a critical factor for enhancing the quality of the decision making process.

[2]. In 2017, the initially established working group reached more than 180 members, following in 2018 the launch of DES (Drone Efficacy Study) which consisted of 50 trials of SAR with and without drones provided by different manufacturers. The tests showed a 77% success rate of locating missing persons with drones in contrast with an 85% success rate without drone use, but drone-enabled SAR provided a three-minute faster response than the traditional operation.

[3]. In 2015, EENA (European Emergency Number Association) organized a Working Group consisting of 125 members from 39 countries that aimed at understanding how drones can be used by the emergency services, SAR (Search and Rescue) and First Responders. Later in the same year, an operation document [3] was released containing information about: how emergency services could use drones and what types of drones would be suitable, legislation at that time, technical considerations (onboard equipment and technology, technical requirements from the emergency services), operational use, safety and privacy.

[4]. The areas that suffer fatigue from high pressure are more prone to cracking than normal. The type of cracks thus formed are called fatigue cracks. Yeum and Dyke [4] have performed crack detection in metal components of bridge infrastructure where they noted cracks close to the bolts in the metal frame due to fatigue. Yeum and Dyke [4] introduced pattern detection for identifying cracks and enhanced the accuracy of detection with the help of Frangi filter and canny edge detector. Frangi filter and canny edge detector are multi-stage pattern recognition algorithms that can accurately identify continuous edges [4]. Frangi filter is also capable of finding the intensity of the edges and can relate that to the whole image. By applying these extra steps to the proposed method, Yeum and Dyke [4] were able to reduce false-positive images in the experiment.

[5]. By the year 2016, the aggressive development of Vibration-based non-destructive testing sensors resulted in them being lighter, smaller, and cheaper. This movement in the industry implied that mounting a various array of sensors to the UAV was now less of a challenge than before. Vibration-based sensors work based on the physical properties of the materials such as stiffness, mass, and dissipation of energy through them [5]. Variation in any of the abovementioned properties can exhibit changes in frequencies, modal damping, and mode shapes, etc.

[6]. Back in the year 2012, Eschmann et al. [6] investigated conventional means of inspecting large scale infrastructure and observed that the main goal was to analyze cracking conditions. Eschmann et al. [6] continued to point out the laborious nature of these procedures and underlined the importance of much-needed UAV assisted inspection methods. Although onfield experiments were promising, the struggles of mounting heavy payloads used for crack detection on UAVs were evident. Collected geo-referenced high-definition RGB images were stitched together to form a large 1.27 Gigapixel image, mostly done manually since it was too complex for the thenexisting pattern recognition algorithms [6]. Detection of cracks was performed by applying Gaussian blur and greyscale intensity to the images and performing edge detection algorithms. The major drawback was that the method was successful only with white or grey walls [6].

V. SOFTWARE DESCRIPTION

1. Arduino IDE

2. Embedded C language for Programming

Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Its hardware products are licensed under a CC BY-SA license, while the software is licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially from the official website or through authorized distributors. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the Arduino Programming Language, inspired by the Processing language and used with a modified version of the Processing IDE. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) and a command line tool developed in Go. The Arduino project began in 2005 as a tool for students at the Interaction Design Institute Ivrea, Italy aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors. The name Arduino comes from a bar in Ivrea, Italy, where some of the project's founders used to meet. The bar was named after Arduino of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

5.1 Software

A program for Arduino hardware may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their 8-bit AVR and 32-bit ARM Cortex-M based microcontrollers: AVR Studio (older) and Atmel Studio (newer)

5.2 Legacy IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Microsoft Windows, mac OS, and Linux) that is written in the Java programming language. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one- click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus. The source code for the IDE is released under the GNU General Public License, version 2.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

From version 1.8.12, Arduino IDE windows compiler supports only Windows 7 or newer OS. On Windows Vista or older one gets "Unrecognized Win32 application" error when trying to verify/upload program. To run IDE on older machines, users can either use version 1.8.11, or copy "arduino-builder" executable from version 11 to their current install folder as it's independent from IDE.

5.3 IDE 2.0

An initial alpha preview of a new Arduino IDE was released on October 18, 2019, as the Arduino Pro IDE. The beta preview was released on March 1, 2021, renamed IDE 2.0. On September 14, 2022, the Arduino IDE 2.0 was officially released as stable.

The system still uses Arduino CLI (Command Line Interface), but improvements include a more professional development environment, autocompletion support, and Git integration. The application frontend is based on the Eclipse The Open Source IDE. Its main new features are:

- Modern, fully featured development environment
- Dual Mode, Classic Mode (identical to the Classic Arduino IDE) and Pro Mode (File System view)
- New Board Manager
- New Library Manager
- Board List
- Basic Auto-Completion (Arm targets only)
- Git Integration
- Serial Monitor
- Dark Mode

VI. HARDWARE REQUIREMENT

6.1 CUBE ORANGE

➢ **Processor**
- 32bit ARM STM32H753 Cortex-M7（with DP-FPU）
- 400 Mhz/1 MB RAM/2 MB Flash
- 32 bit STM32F103 failsafe co-processor

➢ **Sensors :**
- Three redundant IMUs (Accelerometers/Gyroscopes), Two Barometers, One Magnetometer
- ICM 20649 integrated accelerometer / gyro, MS5611 barometer on base board
- InvenSense ICM20602 IMU,ICM20948 IMU/MAG, MS5611 barometer on temperature controlled, vibration isolated board
- All sensors connected via SPI

➢ **Power:**
- Redundant power supply with automatic failover
- Servo rail high-power (7 V) and high-current ready
- All peripheral outputs over-current protected, all inputs ESD protect

➢ **Interfaces**
- 14x PWM servo outputs (8 from IO, 6 from FMU)
- S.Bus servo output
- R/C inputs for CPPM, Spektrum / DSM and S.Bus
- Analogue / PWM RSSI input
- 5x general purpose serial ports, 2 with full flow control
- 2x I2C ports
- SPI port (un-buffered, for short cables only not recommended for use)
- 2x CAN Bus interface
- 3x Analogue inputs (3.3V and 6.6V)
- High-powered piezo buzzer driver (on expansion board)
- High-power RGB LED (I2C driver compatible connected externally only)
- Safety switch / LED

6.2 BATTERY(12V,7Ah)

A rechargeable battery is a battery that can be recharged and used many times and is known as a secondary cell. Gaston Planet, a French physician, developed the world's first rechargeable battery in the year 1859.A battery is like a piggy bank. If you keep taking out and putting nothing back, you'll have nothing left. Present day chassis battery power requirements are huge. All the electronics require a reliable source power, and poor battery condition can cause expensiveelectronic component failure. Life span depends on usage— usually 6 to 48 months—yet only 30% of all batteries actually reach the 48-month mark. You can extend your battery life by hooking it up to a solar charger during the off months. Here, we have used rechargeable battery producing a fully charged output voltage of 12volts, with 7.2 AH. A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between. When electrical energy from an outside source is applied to a secondary cell, the negative-topositive electron flow that occurs during discharge is reversed and the cells charge is restored. A rechargeable battery, storage battery, or secondary cell (formally a type of energy accumulator), is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discharged after use. It is composed of one or more electrochemical cells. The battery stores electrical energy in form of chemical energy and the chemical energy again able to convert into electrical energy. The conversion of chemical energy to electrical energy is called discharging.

6.3 WATER PUMP (12V,3.5A)

The water hits the rotating impeller, energy of the impeller is transferred to the water, forcing the water out (centrifugal force). The water is displaced outward, and more water can now enter the suction side of the pump to replace the displaced water. The working principle of a water pump mainly depends upon the positive displacement principle as well as kinetic energy to push the water. These pumps use AC power otherwise DC power for energizing the motor of the water pump whereas others can be energized other kinds of drivers like gasoline engines otherwise diesel. The water pump is a portable device and can be applied in several household applications. These pumps are used for pumping the huge amount of water from one place to another. The main purpose of a water pump is versatile. A quality pump which can be selected carefully may be perfect for draining water from a low flooded region, refilling the swimming pool, and bathtub, circulating pesticides otherwise fertilizers. The collection of water pumps are very large, therefore, while selecting a strong and consistent one, one should think about the requirement.

6.4 NOZZLE

A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

6.5 SWITCH CONTROL

Switch control is used to on and off the supply to the motor.

6.6 GSM MODULE (SIM 900A)

The SIM900A is a readily available GSM/GPRS module used in many mobile phones and PDA. The module can also be used for developing IOT (Internet of Things) and Embedded Applications. SIM900A is a dual-band GSM/GPRS engine that works on frequencies EGSM900MHz and DCS 1800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. The module is typically connected to +4.0V standard power supply. It can work on +4.5V regulated power and any higher voltage may damage the module. And the power source should be able to deliver a peak current of 2A. The UART interface is established as shown in figure. All you need to do is connect RXD of module to TXD of Arduino and TXD is connected to RXD of ARDUINO. The ground of controller and module must be connected for voltage reference. Here AUDIO IN is connected to MIC and AUDIO OUT is connected to a speaker or headset. And at last we need to connect a working GSM SIM card to the module. On powering the module, the NETLIGHT LED will blink periodically to state successful connection. After all connections are done, we need to write a program for the microcontroller to exchange data with module. Since data exchange sequence between controller and module is really complex we will use libraries prewritten for the module. You can download libraries for controller or module through their websites. Using these libraries makes the communication easy. All you need to do is download these libraries and call them in programs. Once the header file is included, you can use simple commands in the program to tell the controller to send or receive data. The controller sends the data to the module through UART Interface based on protocol setup in libraries. The module sends this data to another GSM user using cellular network. If the module receives any data from the cellular network (or another GSM user) it will transmit it to controller through UART serial communication. This way we can use GSM900A module to establish cellular connection.

➢ **FEATURES AND SPECIFICATIONS**
- Single supply voltage: 3.4V – 4.5V
- Power saving mode: Typical power consumption in SLEEP mode is 1.5Ma
- Frequency bands: SIM900A Dual-band: EGSM900, DCS1800. The SIM900A can search the two frequency bands automatically. The frequency bands also can be set by AT command.
- GSM class: Small MS
- GPRS connectivity: GPRS multi-slot class 10 (default) , GPRS multi-slot class 8 (option)
- Transmitting power: Class 4 (2W) at EGSM 900, Class 1 (1W) at DCS 1800
- Operating Temperature: -30ºC to +80ºC
- Storage Temperature: -5ºC to +90ºC
- DATA GPRS: download transfer max is 85.6KBps, Upload transfer max 42.8KBps
- Supports CSD, USSD, SMS, FAX
- Supports MIC and Audio Input
- Speaker Input
- Features keypad interface
- Features display interface
- Features Real Time Clock
- Supports UART interface
- Supports single SIM card
- Firmware upgrade by debug port
- Communication by using AT commands

➢ **APPLICATIONS**
- Cellular Communication
- Robotics
- Mobile Phone Accessories
- Servers
- Computer Peripherals
- Automobile
- USB Dongles

6.7 ARDUINO UNO (REES52,ATmega 328P)

The Arduino Uno is a microcontroller board that uses the ATmega328P microcontroller. There are 14 digital input/output pins (six of which can be used as PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button on the board. It comes with everything you'll need to get started with the microcontroller; all you have to do is plug it into a computer via USB or power it with an AC-to-DC adapter or battery. You can tinker with your Uno without fear of making a mistake, and if something goes wrong, you can replace the chip for a few dollars and start over. In Italian, the word "uno" means "one," and it was chosen to commemorate the release of Arduino Software (IDE) 1.0. The Uno board and Arduino Software (IDE) version 1.0 were the reference versions of Arduino, which have since been superseded by newer releases. The Arduino Uno board is the first of a series of USB Arduino boards and the platform's reference model; see the Arduino index of boards for a comprehensive list of current, historical, and obsolete boards.

➢ **SPECIFICATIONS**
- The operating voltage is 5V
- The recommended input voltage will range from 7v to 12V
- The input voltage ranges from 6v to 20V
- Digital input/output pins are 14
- Analog i/p pins are 6
- DC Current for each input/output pin is 40 mA
- DC Current for 3.3V Pin is 50 mA
- Flash Memory is 32 KB
- SRAM is 2 KB
- EEPROM is 1 KB
- CLK Speed is 16 MHz

➢ **PURPOSE OF ARDUNIO**

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

➢ **ADVANTAGES OF ARDUNIO**
- The Arduino programming language is based on C++, with a simple and straightforward syntax that is easy to pick up even for beginners.
- Easy to Learn and Use.
- Versatility.
- Widely Supported.
- Cost-Effective.
- Open Source

6.8 TEMPERATURE SENSOR

A Flame Sensor module or Fire Sensor module is a small size electronics device that can detect a fire source or any other bright light sources. This sensor basically detects IR (Infrared) light wavelength between 760 nm – 1100 nm that is emitted from the fire flame or light source. The flame sensor comes with a YG1006 Phototransistor sensor which is a high speed and high sensitivity. Two types of IR Infrared Flame Sensor Module available in the market one having three pins (D0, Gnd, Vcc) and another one having four pins (A0, D0, Gnd, Vcc) both are can be easily used with Arduino and other microcontroller boards. Phototransistor is a 5mm NPN Transistor. The Phototransistor is coated by black epoxy, which makes it sensitive to infrared radiation. But, it looks like a two-terminal block LED from the outside. It is used to sense flame or light in a range of 760 nm – 1100 nm wavelength. This sensor is consists of two terminals, where the long terminal is the Emitter and the shorter terminal is the collector. It has no base terminal like other transistors, when it detects light then the current starts to flow between emitter and collector. This sensor has an onboard variable resistor (potentiometer), this is a 10k preset. Rotate the preset knob to adjust the sensitivity of fire detection. If the preset knob rotated clockwise, the sensitivity of the Flame sensor will be increased. If it rotated counterclockwise, the sensitivity of the Flame sensor will be decreased.

6.9 JUMPER WIRE

A jumper wire is an electric wire that connects remote electric circuits used for printed circuit boards. By attaching a jumper wire on the circuit, it can be short-circuited and short-cut (jump) to the electric circuit.

6.10 PIPE

A pipe is a tubular section or hollow cylinder, usually but not necessarily of circular cross- section, used mainly to convey substances which can flow — liquids and gases, slurries, powders and masses of small solids.

6.11 WATER CONTAINER

A usually large container for holding, transporting, or storing liquids.

6.14 SERVOMOTOR HOBBY WING

The Field Oriented Control-based Permanent Magnet Synchronous Motor algorithm, an optimized algorithm for improving the collaborative performance of the ESC, motor & propeller, makes the motor-propeller more balanced and creates a propulsion system features high stability, reliability and efficiency. The X8 propulsion system is waterproof to IPX7 standard. It's applicable to almost all the harsh working conditions like rainwater, pesticides, salt spray, high temperature, sand and dust. The ESC included in the X8 power propulsion, which features a series of protection like power-on self test, power-on abnormal voltage, over-current and motor lock-up, can output the running data like input throttle, output throttle, RPM, input voltage & current, output current, capacitor temperature and MOS temperature to the FC (Flight Controller) in real time to allow the FC to know the running status of the (ESC & motor) power combo in real time, and improve the flight performance, efficiency and reliability of the drones. The high-strength CNC-machined aluminum alloy frame combined with the optimized structure design protect the motor components effectively, make the motor really impact-resistant, and greatly reduce the possibility of structure deformation/malfunction caused by drop or hit.

6.15 LIPO BATTERY (10000 mAW ,11.1V)

A LIPO (Lithium Polymer) battery is a type of rechargeable battery that offers high energy density and low self-discharge rate. This makes them ideal for use in drones, which require long flight times and need to be able to maintain power during extended periods of inactivity. LIPO batteries are also relatively lightweight and compact, another important factor for drones which need to be as light as possible to stay airborne. Most drone manufacturers will offer LIPO batteries as an option for their products, and it's generally advisable to go with this type of battery over others such as NICD or NiMH if you want the best performance from your drone. That said, LIPO batteries can be more expensive than other types and they do require some special care when charging and storing.

6.17 PROPELLERS

A drone's propellers are essential to keeping a drone in the air. These spinning blades produce airflow, which lifts the drone in the air. The most preferred material for drone blades is carbon fiber because of its many advantages. Carbon fiber blades are the strongest, stiffest, and lightest of them all. Also, they offer less inertia and vibration, allowing for faster speed change. One of the most important parts of your drone are the propellers. These spinning blades are the wings to your craft, the very part that creates the airflow that lifts your machine into the air. Drone propellers come in many different shapes and sizes – they all serve the same overall purpose, but the flight characteristics of each can be dramatically different.The propeller on your drone is a wing, actually, in the physics sense of things, it is multiple wings attached together. Spinning the little wings around in a circle creates the same air pressures, thus causing lift.The basic concept of a fixed blade propeller is that the faster the motor runs, the faster your propeller spins and more lift is created. Basically, more power = more speed. There will be a theoretical maximum to this, eventually a propeller will spin faster than it can efficiently move air, but for the most part we won't hit that with our consumer drones.

6.18 Hex Here3 CAN GNSS Module

- Processor: STM32F302
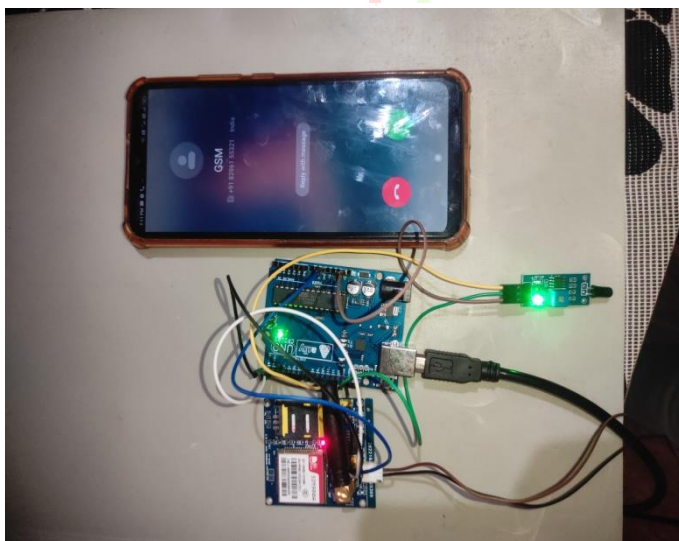- IMU Sensor: ICM20948

VII.   ADVANTAGES

- There is no pull up load
- Can enter any environment
- Saves human life
- Extinguishing agent can be refilled

VIII.   CONCLUSION

In this project we have made real time model of smart drone fire extinguisher in the model we are using Arduino ,GSM module, flame sensor. The flame sensor connect to the GSM through Arduino, flame sensor detects the fire and GSM will make a call to the number which is provided in the code. Extinguishing made by the nozzle manually through the water pump once after getting the call.

IX.   RESULTS

X.ACKNOWLEDGMENT

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