

FABRICATION OF DRONE TO AID SOLID WASTE MANAGEMENT

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree
in
Mechanical Engineering

by

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(DEEMED TO BE UNIVERSITY)**

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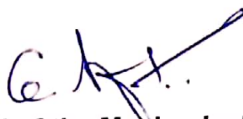
BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Lakku Dharma Teja (38150059)** and **Sepana Harikrishna (38150106)** who carried out the project entitled **"FABRICATION OF DRONE TO AID SOLID WASTE MANAGEMENT"** under my supervision from November 2021 to March 2022.


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We, Lakku Dharma Teja (38150059) and Sepana Harikrishna (38150106) hereby declare that the Project Report entitled "FABRICATION OF DRONE TO AID SOLID WASTE MANAGEMENT" done by me under the guidance of Dr.J.Hemanandh M.E., Ph.D., is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

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ABSTRACT

Collection of garbage from water bodies has always proven to be a difficult task which may result in severe injuries or may sometimes lead to life loss. Unmanned Aerial Vehicle (UAV) has proven to be an effective, simplistic and affordable solution. A brushed-motor driven Quadcopter is assembled wherein it can be controlled either autonomously or by remote control. This drone requires remote control operation. A SG90 model Gripper is then connected to an Android mobile of the remote pilot via Bluetooth and Arduino. An Android application is developed to control the drone remotely. The gripper is then attached. The Gripper mechanism was controlled using an Android application which was developed for this purpose. Android device is connected to Gripper mechanism by pairing both using HC05 bluetooth module and finally performance analysis was carried out.

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ABBREVIATIONS

UAV	-	Unmanned Aerial Vehicle
MATLAB	-	Matrix Laboratory
GPS	-	Global Positioning System
RF	-	Radio Frequency
HAE	-	High-Altitude Endurance
DARPA	-	Defense Advanced Research Projects Agency
DARO	-	Defense Airborne Reconnaissance Office
SCARA	-	Selective Compliance Articulated Robot Arm
I/O	-	Input/Output
IDE	-	Integrated drive electronics
PWM	-	Pulse Width Modulation
LED	-	Light Emitting Device
ESC	-	Electronic Speed Controller
DC	-	Direct Current
DMAIC	-	Define Measure Analyze Improve Control

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO DRONE TECHNOLOGY

There are a number of different types of unmanned aerial vehicles (UAV). Drones are just flying robots. Using GPS and integrated software, the flying machine may be remotely commanded or fly autonomously using flight plans. Drones are most often used by the military. There are a variety of other applications for weather and fire detection and suppression systems as well as search and rescue efforts, as well as surveillance and traffic monitoring, amongst others. Drones have gained notoriety in recent years for a variety of business applications. It was stated in late 2013 that Amazon will begin using unmanned aerial vehicles (UAVs) for delivery in the region. It's called Amazon Prime Air, and it's expected to deliver items within a 10-mile radius in 30 minutes or less, according to Amazon's website. As a result, it's evident that civilian UAV use has a far brighter future than military UAV use.

In the mid-1990s, the Defense Advanced Research Projects Agency (DARPA) and the Defense Airborne Reconnaissance Office (DARO) launched the High-Altitude Endurance Unmanned Aerial Vehicle Advanced Concept Technology Demonstration (HAE UAV ACTD) programme (DARO). The Global Hawk's foundation was laid by this ACTD. The Global Hawk can fly for up to 35 hours at 340 knots at a height of 65,000 feet, and it costs around \$200 million to operate. Wing span is 116 feet and it had a top speed of 13.8094 mph. Global Hawk was created primarily to meet the demands of national security and anti-drug legislation. With the Hellfire missiles, Predator was another successful UAV developed in the mid-1990s. Air and Space Magazine recorded the Predator as one of the main 10 most changed airplane on the planet and the most battle tried automated airborne framework (UAS) on the planet. General Atomics fostered the primary Predator, which can fly at a height of 25,000 feet for 40 hours at a greatest speed of 120 miles each hour.

1.2 INTRODUCTION TO ROBOTIC GRIPPER MECHANISM

The hands have always been the most important portion of our bodies for our interactions with the outside world. It's pointless to be able to comprehend a large quantity of information at lightning speed in the brain if you can't act on it. The prehension tools on robots are referred to as "grippers" because they are akin to the organs of human manipulation: the hands. In most applications, the only portion that comes into direct touch with the work piece is the kinematically last link in the chain. Subsystems of handling mechanisms that enable momentary touch with the item to be grabbed. When the item is being carried and mated to the handling equipment, they make sure it is in the correct position and orientation. Force-producing and form-matching components are used to achieve prehension. No real gripping occurs, but the item is held in place by the retention force of the "gripper," which may operate on a point, line, or surface in vacuum suction, for example.

1.3 ISSUES RELATED WITH USAGE OF DRONES

Drone concerns may be broken down into a variety of categories, including those pertaining to morality, ethics, and the law. The use of drones for social reasons is now legal in certain countries, despite the fact that many countries still prohibit the use of drones. In addition, a respectable drone industry has sprung up in Singapore, although its use raises certain ethical questions. To expand their businesses, military drone makers are also exploring for ways to deploy remote-sensing drones in civilian applications, including surveillance. Inevitably, drones will enable a major shift in the surveillance state. It may even be feasible for machines to recognise faces, actions, and particular conversations via the confluence of other technologies. Civil society has taken the lead in researching drone strikes in the absence of official transparency. According to the Bureau of Investigative Journalism at City University in London, which is a non-profit organisation, the size of such US activities may be explained. For example, the Bureau estimates that between 2004 and 2012, there were 330 attacks in Pakistan, resulting in the deaths of 2479 to 3180 persons (plus over 1,000 injuries); the United States has directed somewhere in the range of 44 and 54 activities in Yemen (counting 31 to 41 robot strikes), with an extra 87 to 96 tasks

(perhaps) being thought of (counting 49 to 55 robot strikes). Between 317 and 826 persons were claimed to have been murdered. Advocates of drone use point out that the operators' separation from the battlefield enables them to draw on a broader variety of supporting data when making choices. Because of this, it is more probable that those who are physically and emotionally far from a target are simpler to murder. There is no evidence to suggest that supporting data aids in the development of better legal and ethical judgments. According to the statistics, drone strikes have resulted in a large number of civilian casualties, which further dehumanises war. A PlayStation mindset has also been emphasised by the rapporteur, in which drone operators see their acts as a game.

1.4 CLASSIFICATION OF GRIPPERS

There are four main groups of grippers that can be used for different tasks, which can be categorised as follows.

1.4.1 *Impactive gripper*

It is a mechanical gripper in which the prehension force is created by impacting the item from at least two directions. Are the most often used in the business for selecting hard items, such as clamps or tongs, employing them.

1.4.2 *Ingressive gripper*

Perception is accomplished by using a prehension instrument that penetrates the work item Pins, needles, and hackles may be invasive since they physically infiltrate the cloth, while alternative techniques, such as hook and loop, such as Velcro, can be non-intrusive. It is usual practise to incorporate them into fabrics and other pliable things.

1.4.3 *Astrictive gripper*

You don't need to touch each other at first, but you may use air movement, magnetism or electroadhesion in one direction to tie the object to your grasped hand or fingertip. Can be used for grasping.

The vacuum suction requires nonporous and hard materials; magnetoadhesion requires ferrous materials; and electroadhesion is only applicable for light sheet materials and micro components. All other methods of acquisition need flexible or porous materials.

1.4.4 Contigutive gripper

You need direct contact between the object's surface and your prehension means no impact to get a strong grip. According on the force that is applied, the contiguous grippers may be characterised as adhesions based on chemical bonding, thermal adhesion, or surface tension.

Gripping approaches may then be narrowed down to the most appropriate for picking up the 10 daily necessities. The astrictive approach may be disregarded since not all of the pieces are made of metal, light sheet, or nonporous. A teddy bear is not the ideal solution since it is made of textile, much as the aggressive one only works with a small number of ingressives. Due to the peculiarities of the approach, neither the contigutive gripper nor the gripper is an appropriate candidate. As a result, an impactive gripper is the finest option since it is able to grab all of the items described with their wide range of forms and materials.

1.5 CLASSIFICATION OF DRONES

Drones can be classified according to their design (fixed wing, multi-engine, etc.), autonomous level, size and weight, and power source, among other characteristics. Specifications like cruise range, flying time, and payload capacity are all crucial considerations when building the drone's flight envelope and design. Different payloads (e.g. parcel post, pharmaceuticals, fire extinguishers, flyers, etc.) and different types of sensors (e.g. cameras inhalers, meteorological sensors, etc.) are distinguished, including freight forwarding. .) Various payloads are discussed in this section. To complete the flight, drones require radio communication with the pilot on the ground. In most cases, a payload, such as a camera or sensor, also requires communication. In order to enable this communication to occur,

The frequency spectrum is necessary. Drone types, flying characteristics, and payload all have an impact on the frequency spectrum needed to operate them.

Drone payloads and applications are dependent on (gradations within) the features of the drone. Also, drones are often classified based on the following characteristics:

The kind of drone is an essential technological aspect of drones, as described above. Fixed-wing and multirotor drones are the two most common varieties. Both of these kinds are responsible for the bulk of drones currently in use today.

1.5.1 Fixed Wing systems

It is normal in the flight business to utilize the expression "fixed wing" while alluding to airplane that utilization steady, fixed wings joined with forward velocities to deliver lift force. Examples of these types of aircraft are model aircraft, surface-attached kites and other types of gliders such as hang gliders or gliders. Fixed-wing systems may even be found in a basic paper aircraft. Fixed-wing drones like the Raven are often utilised.

1.5.2 Multirotor systems

Rotorcraft include multirotor systems as a subcategory. To describe an aircraft with rotating wings, the word "rotorcraft" is used. The classic helicopter is a well-known rotorcraft. One or more rotors may be used in rotorcraft. Multiple tiny rotors are required for the stability of rotary system drones, thus the term "multirotor systems." At least four rotors are required to keep these drones in the air. DJI's Phantom drone is a prominent example of a multirotor drone, and is frequently utilised.

Fixed-wing and multirotor drones have crucial differences for the many uses that buyers wish to put their drone to use for. Unlike fixed-wing aircraft, multirotor drones don't need a landing strip, are quieter, and can hover in the air. Drones with fixed wings go further and quicker. More suited to long-distance travel than multirotors. For a given application, the qualities of these drones dictate which one to utilise.

1.6 TYPES OF QUADCOPTER DRONE FRAMES

1.6.1 Monocopters

There is just one motor in a monocopter as shown in Fig 1.1, hence it can only move up and down with the help of that one motor. If an airflow difference cannot be produced to steer the drone, then monocopters are out of the question. You can't yaw or turn your drone with a monocopter since it doesn't have rotors. Adding more motors also improves the drone's stability. More airflow may be achieved by increasing the number of motors, increasing the number of wings, and decreasing the angle between the arms. Drones with larger motors can lift greater weight, allowing you to carry more equipment.



Fig 1.1: Monocopter

1.6.2 Bicopters

Bicopters generally feature two fixed-pitch propellers as shown in Fig 1.2, one clockwise (CW) and the other counterclockwise (CCW) (CCW). By adjusting the speed of each rotor one by one, it can get the desired amount of thrust and have precise control. Keep the thrust center horizontal and longitudinal and generate the required amount of torque or torque by adjusting the speed of rotor.



Fig 1.2: Bicopter

1.6.3 Tricopters

Propellers on tricopters are normally three-bladed as shown in Fig 1.3 and have a set pitch. Unlike bicopters, they can fly in several directions and carry a significant weight. The distal segment of the limbs of tricopters feature three motors arranged in a Y or T configuration. You'll note that a tricopter is more stable than a bicopter since it has an additional blade. A tricopter, on the other hand, may become shaky even in a little wind. The stability of tricopters is superior to that of quadcopters, but the speed and performance of quadcopters are superior as well.



Fig 1.3: Tricopter

1.6.4 Quadcopters

It's true that quadcopters are by far the most popular multirotor aircraft. As it has been shown time and time again, four is the best number of quadcopters for balancing the cost, performance, stability, and flying time of any drone. A

quadcopter is a multi-rotor drone with four propellers on each rotor as shown in Fig 1.4. This Drone uses an electrical sensor and control system to maintain its altitude and maintain a steady course. Quadcopters come in three basic shapes: the plus, cross, and h- shaped quadcopters.



Fig 1.4 : Quadcopter

1.6.5 Hexacopters

In the hexacopter, there are six propellers that revolve around the hexacopter's body as shown in Fig 1.5. Leg-like extensions on the machine's bottom enable it to securely touch down on the ground while in flight. When compared to the quadcopter, the quadcopter has six propellers, which gives it greater power and allows it to carry more weight. As an added benefit, if one of its six propellers' breaks, the aircraft will be able to continue flying thanks to the remaining four working ones.



Fig 1.5: Hexacopter

1.6.6 Octocopters

If you're looking for the most powerful quadcopter or hexacopter, look no further. With these new drones, you'll be able to fly higher, faster, and carry more weight than ever before. Since the octocopter maintains a very stable position in the air, it can shoot video with excellent visual clarity and minimum motion blur. Due to their high level of performance, these drones are regarded as the pinnacle of the drone market. Because they're used for highly specialised duties, they may be exposed to rain or windy conditions. It is shown in Fig 1.6.



Fig 1.6 : Octocopter

1.7 TYPES OF MOTORS

1.7.1 Brushed motor

The brushed motors are the oldest motors in the history of the automobile. The machine's rotor, which revolves, is powered by a carbon brush mechanism. In contrast, a permanent magnet is used to make the stator. It is as shown in Fig 1.7.

1.7.2 Brushless motor

Electromechanically commutated DC motors (ECM or ECM motors), commonly known as brushless DC motors or brushless DC electric motors, are direct current (DC) synchronous motors with a brushless design as shown in Fig 1.7.

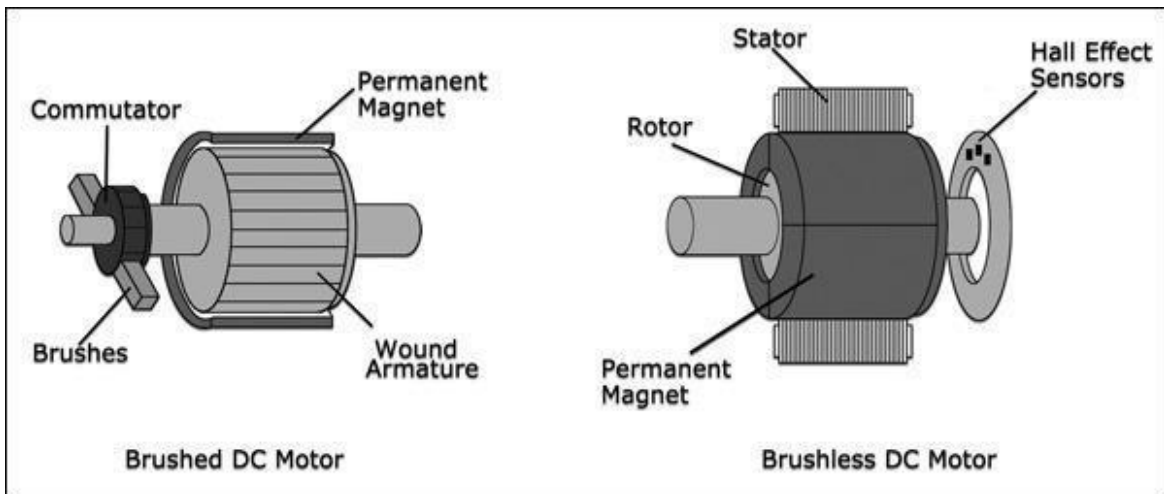


Fig 1.7: Brushed DC Motor and Brushless DC Motor

CHAPTER 2

LITERATURE SURVEY

1. Ahirwar, S., Swarnkar, R., Bhukya, S. and Namwade, G., 2019 Drones, for example, have the ability to solve a variety of large and little issues in agriculture. Agribusiness employs drones for a variety of purposes, including irrigation, crop monitoring, soil and field research, and even bird control, to name a few.
2. Frachtenberg, E., 2019 Several major obstacles must be overcome before the promise of delivery drones can be fully realised. These as-yet-unsolved issues are a hotbed of research and regulation, and the successful deployment of delivery drones is contingent on the development of practical answers.
3. Irizarry, J., Gheisari, M. and Walker, B.N., 2012. This article explains why safety is a top priority in such a lucrative sector. Personal protective equipment, safety-conscious design, and other technical improvements have led to a rise in the number of people who are able to work in a safe environment.
4. Jun, B.S., Kook, Y.S., Park, J.S. and Won, C.Y., 2018 This study discusses the advancement of electronic speed control (ESC) in PMSMs for drones. Newly developed drones are constrained in terms of their capacity, weight, and price. With this in mind, engineers are now working on an all-in-one model that includes everything from the propeller to the ESC. These PMSM drones are characterised by their great efficiency, high density, simplicity of control, and high rotation speed. In addition, there is no sensor to assess speed in order to minimise the drone's volume and weight.
5. Krishnan, R., 1987, Because of this, deciding on the right motor drive for a certain application may be a difficult task, as this article explains. To decrease the intricacy of the issue, it is important to analyze and assess

different servo drives utilizing a standard arrangement of determination measures. Cost, power thickness, force to-latency proportion and power thickness, as well as force to-idleness proportion, stator current for feeble field and stator cases, warm limits and other control concerns, for example, slowing down and sprocket force are all important for this methodology .

6. Li, T., Liu, J., Zhang, W., Ni, Y., Wang, W. and Li, Z., 2021 Research suggests that the UAV-Human model will drive the development and use of different dataintensive learning methods for the understanding of human behaviour by UAV. Also suggested is a GT-I3D network for the detection of distorted video activity captured with a fisheye lens.
7. Liu, R.L., Zhang, Z.J., Jiao, Y.F., Yang, C.H. and Zhang, W.J., 2019 the paper used an engine simulation test and theoretical derivation to investigate the impact of an opposed-piston gasoline engine on the flight performance of a UAV, and it came up with variation rules for propeller thrust characteristics, manoeuvrability, flight envelope, flight distance, and time.
8. M. Tká and P. Mésáro, 2019. Using aerial photogrammetry to create buildings, bridges, roads, and highways, drones can also be used to improve communication and safety on construction sites, as well as to take topographic measurements of large areas. All of these applications can reduce the time and expense of construction projects.
9. MacNeill, R., Verstraete, D., and Gong, A., 2017 cited This study outlines a strategy for improving the efficiency of unmanned aerial vehicles' propellers. Propeller advancement may now be done couple with the powertrain of the air vehicle being referred to, whether it is fueled by a gas powered motor or an electric engine, on account of another strategy that has been created . Using this approach, you'll have a propeller that's as efficient as possible while still being as light as possible.
10. Ritchie, M., Fioranelli, F., Griffiths, H. and Torvik, B., 2015 This article analysed the threat posed by micro unmanned aerial vehicle platforms, as

well as the rotor blade reflections that radar systems are interested in. The predicted variations as a function of variables like as frequency, azimuth angle, and polarisation were subsequently shown using EM simulations of individual rotor blades.

11. Shin, Y.T. and Teh, Y.K., 2018 With a special emphasis on the drone's electrical speed controller, this research examines the design of power electronics (ESC). For the 3-phase motor driver, the power loss and flight time estimation models are computed and compared using the most advanced Silicon Insulated Gate Bipolar Transistor (Si-IGBT) and wide-bandgap semiconductor duals, i.e. silicon carbide (SiC) and Gallium Nitride (GaN) power transistors, respectively.
12. Toleos Jr, L.R., Luna, N.J.A.B.D., Manuel, M.C.E., Chua, J.M.R., Sangalang, E.M.A. and So, P.C., 2020 the researchers can conclude that this study was able to determine the feasibility of using Fused Deposition Modeling to manufacture propellers for Unmanned Aerial Vehicles by determining if the performance and mechanical strength of the 3D printed propellers are the same as injection moulded propellers after completing the activities discussed in this paper, as well as the data analysis and interpretation.
13. Toyama, S. and Nishizawa, U., 2019 ,the autonomous underwater vehicle (AUV) has advanced in Europe and America's technological development for military and national defence purposes. Their primary goals, however, are areas of the water that are less than 200 metres deep. The proper operation of an AUV aimed toward the deep-sea of the ocean has yet to be realised.
14. Van de Straete, H.J., Degezelle, P., De Schutter, J. and Belmans, R.J., 1998 this study discusses the first question of feasibility in general. It creates a criterion as a practical tool for eliminating any motors that cannot drive the specified load, regardless of the reducer's transmission ratio. It's pointless to contemplate such motors in a future cost analysis. As a result, this criterion will accelerate the entire drive selection process.

15. Vergouw, B., Nagel, H., Bondt, G. and Custers, 2016. This explains why drones need to be able to communicate with a pilot on the ground in order to fly. This connection is necessary since many payloads include cameras and sensors. This communication relies on a wide range of frequencies.
16. worker safety. Xue, X., 2019 An electronic speed controller (ESC), battery pack, sensor system, and remote controller are all part of the drone's flying system. The speed of electric motors is controlled by the ESC (Electric Speed Control) subsystem. High-end drones utilise permanent magnet synchronous motors (PMSM) and field-oriented control (FOC) algorithms because of their superior performance.
17. Yallappa, D., Veerangouda, M., Maski, D., Palled, V. and Bheemanna, M., 2017, This method is particularly beneficial in situations when human interaction is not possible, such as spraying pesticides on rice fields and orchard crops, as well as crops on terrain areas 34. Improves coverage, increases chemical efficacy and speeds up the process of spraying.
18. Yi, B.J., Na, H.Y., Lee, J.H., Hong, Y.S., Oh, S.R., Suh, I.H. and Kim, W.K., 2002 The term "configuration control" refers to the study of regulating the shape of a robot configuration using kinematic redundancies. Traditionally, however, research on this topic has been limited to kinematically redundant serial manipulators.
19. Yoon, M., 2015 Propulsion subsystem and ESC driving signal are linked in a dynamic relationship. Onduration (PPM) mode may be used with a low frequency PWM signal (typically 50Hz to several hundred Hz) or duty-ratio mode (with a substantially higher frequency PWM signal of several kHz).
20. Zareei, M.H., Carnegie, D.A., Kapur, A. and McKinnon, D., 2014, DC motors' continual buzzing is rhythmically and timbrally modified in order to highlight the potential auditory aesthetics of some of the most common electromechanical components in our everyday electronics

CHAPTER 3

AIM AND SCOPE OF THE PRESENT INVESTIGATION

3.1 AIM OF THE PROJECT

The primary aim of this project is to fabricate a drone with gripper to aid floating waste from hazardous water bodies.

3.2 SCOPE OF THE INVESTIGATION

Now-a-days the number of skilled workers are increasing from day to day and the number of unskilled workers are getting reduced because of interest developed on education in the society. Though it's a positive sign, as a result of this the workers who are being employed to clean the junk in our locality are also getting reduced but the work load remains same. So with less number of workers and heavy work, they are not able to concentrate to clean up debris (sewage) in the water bodies.

Our main idea of this project is to replace this human power with UAV technology which is most commonly known as Drone Technology. With this technology we can increase the efficiency of the work done with a single person controlling the drone. This technology also eliminates unfortunate accidents which happens to workers who cleans debris manually, the accident may happen in any form like slipping, getting washed away by high paced tides/flow, septic may also happen while walking in the water.

With our Technology we need not worry about the depth of the water, pace of the water flow, amount of man-power needed. A single drone with a single operator can take care of all these things if sufficient payload and power is provided.

CHAPTER 4

MATERIALS, METHODS AND ALGORITHMS USED

4.1 MATERIALS USED IN THE PROJECT

- Robotic Arm Gripper
- Arduino UNO
- Bluetooth module - HC05
- Lead acid battery- 12V 1.3AH
- HW battery
- SG90 servo motor
- Connecting cables
- Mobile app development to control gripper
- Multi-rotors
- Drone Frame
- Brushed motors
- Micro-controllers
- RC with servos and Microcontrollers
- Camera
- Mobile phone to control camera actions
- Some other basic components like glue-gun, rivetts,etc.

4.1.1 Robotic Arm Gripper

As described earlier in the report, there are various kinds of Grippers available and we have to select the most suitable one for our project. So we chosen impactive gripper for our prototype because our prototype needs to pick up small plastic waste which floats on water bodies and requires only force closure mechanism, so the complex mechanism grippers won't be necessary in our project application.

4.1.1.1 Impactive gripper

It is a mechanical gripper in which the prehension force is created by impacting the item from at least two directions. Are the most often used in the business for selecting hard items, such as clamps or tongs, employing them.

4.1.1.2 Gripper mechanism Design

Impactive Grippers can hold objects using force against it's jaws or clamps. This mechanism is most commonly known as force closure and looks as shown in Fig 4.1.

Grippers or mechanical fingers are often used to perform the grasping mechanism. Industrial robots performing particular tasks in simpler applications are often equipped with two-finger grippers. It is possible to swap out the fingers. The form of the surface to be grabbed and the force necessary to hold the item are both taken into consideration by two kinds of two-finger gripping systems. The form of the gripping surface of the fingers may be customised to match the shape of the manipulable items. As an example, a concave imprint of the object's surface may be used as the gripper surface form when the robot is meant to lift it. The surface of a square form may be a plane. '

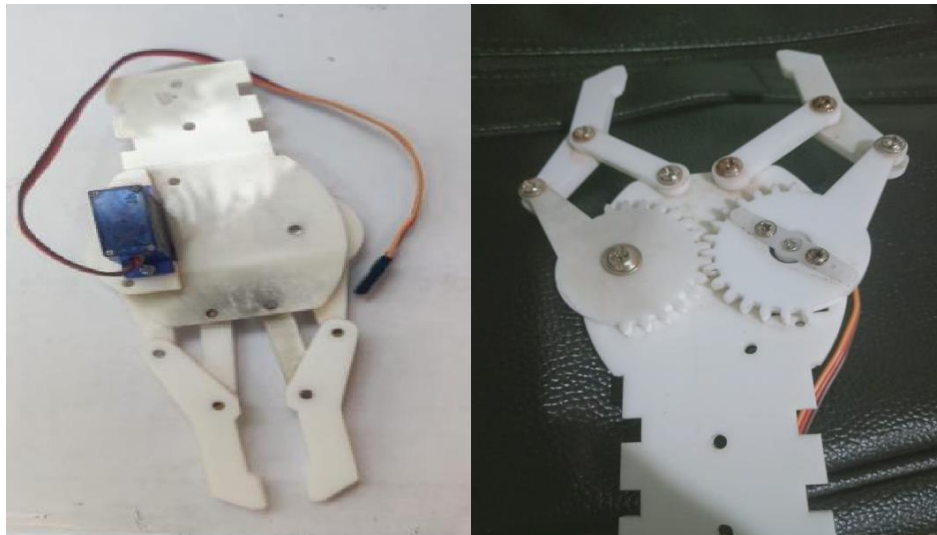


Fig 4.1: Robotic Gripper assembled with SG90 servo motor

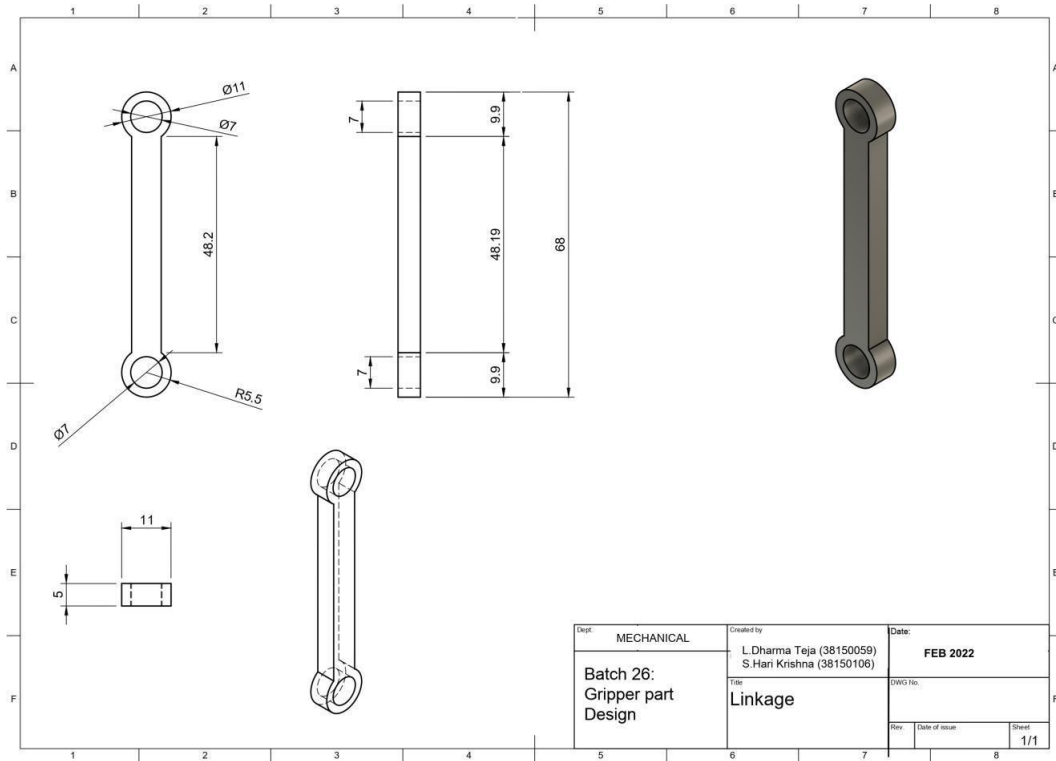


Fig 4.2 : Linkage part design

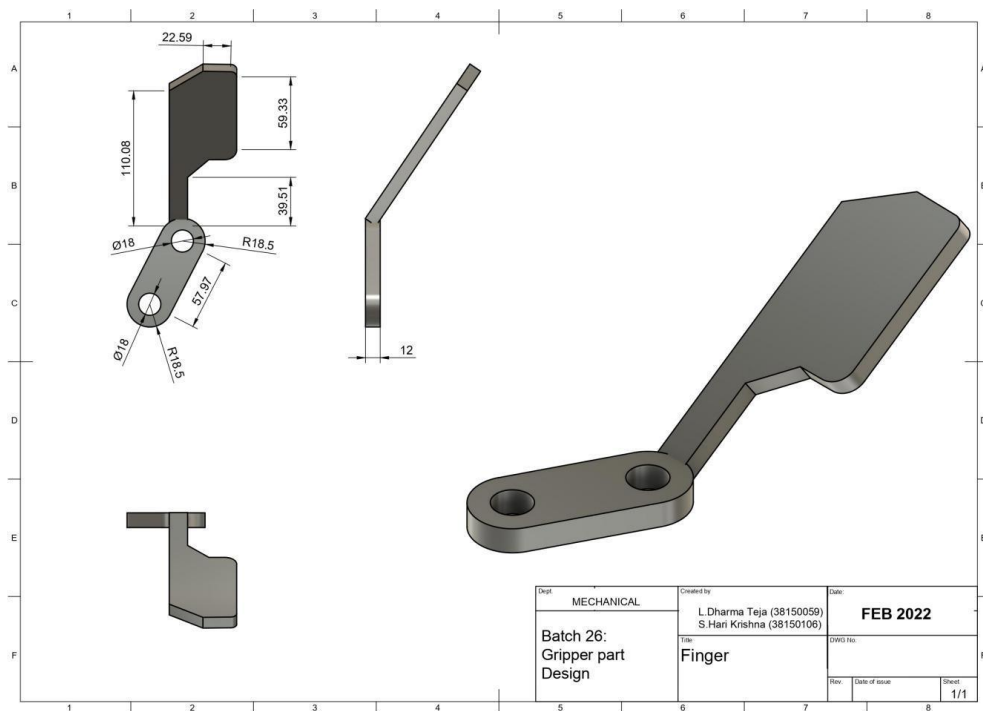


Fig 4.3 : Finger part design

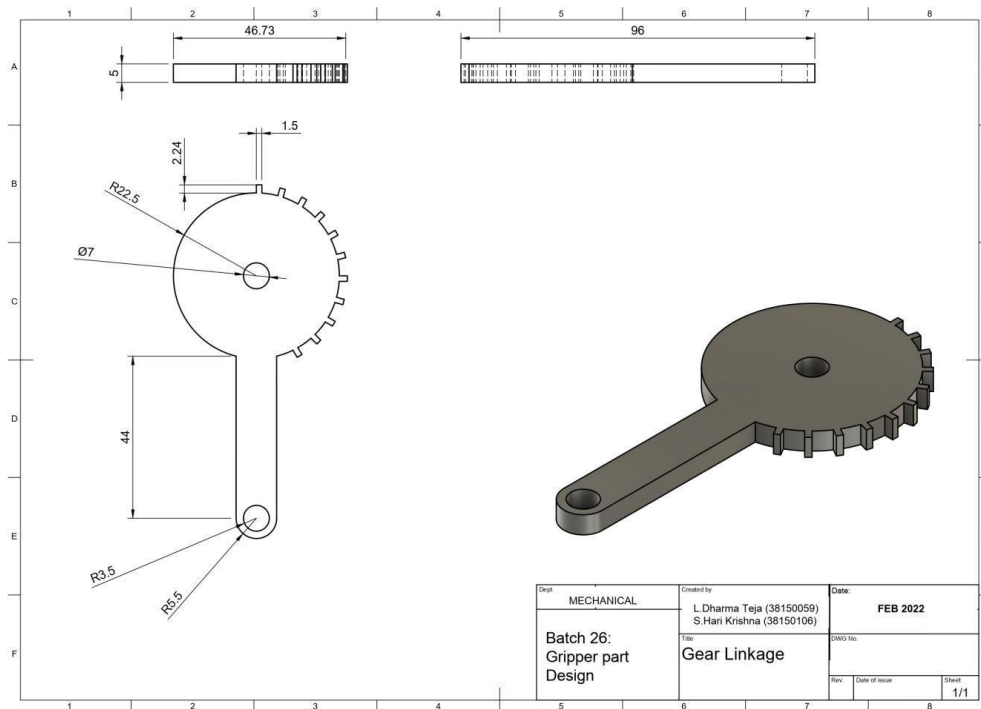


Fig 4.4 : Gear Linkage part design

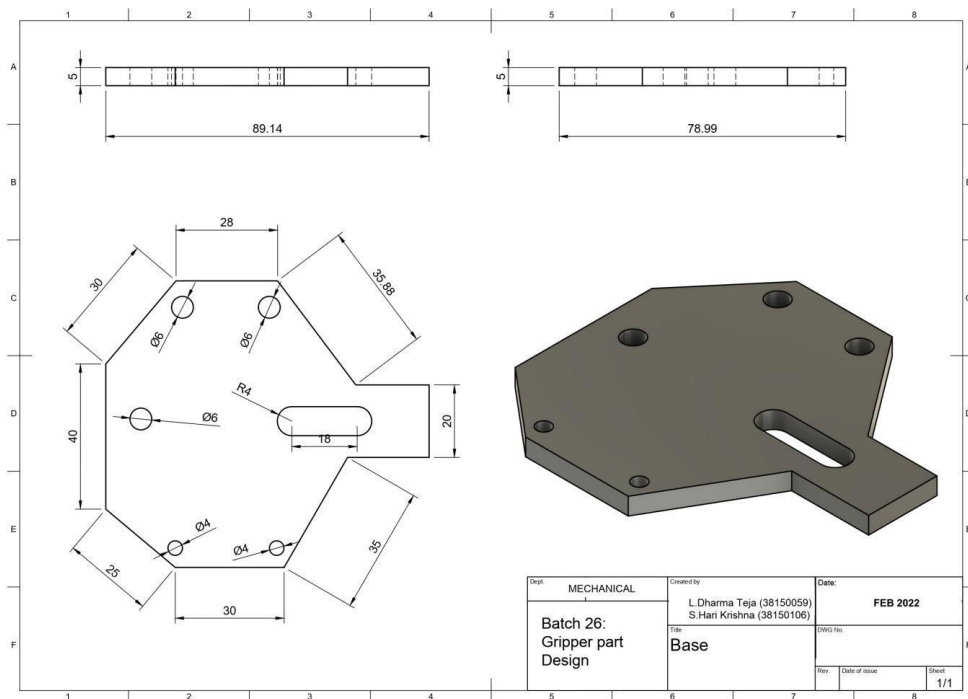


Fig 4.5 : Base part design

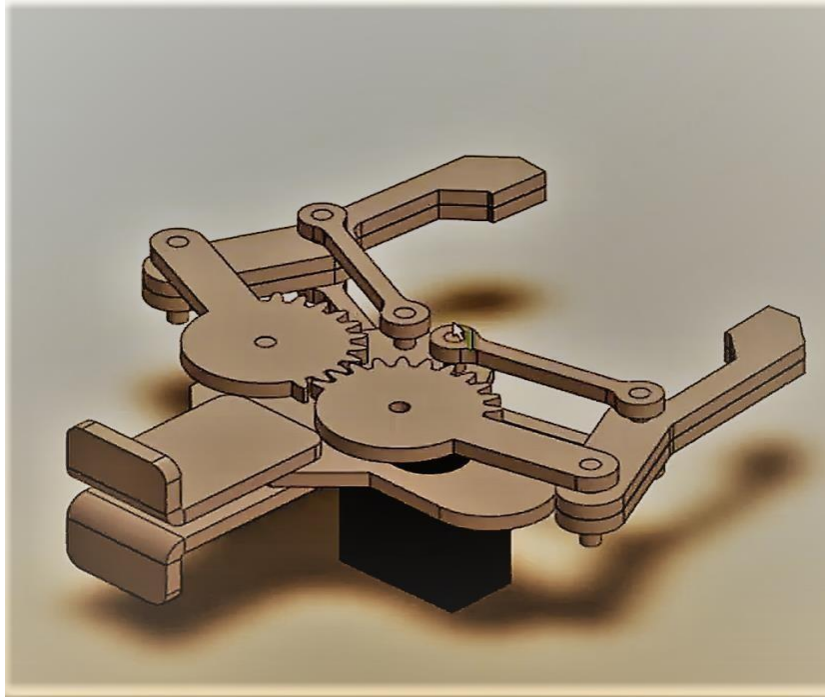


Fig 4.6 : Robotic Gripper Assembled design made in CATIA V5 software

4.1.1.3 Force required to grip an object

There are several forces at play when a robot arm lifts a person, but the most important factor is friction. Using a soft substance with a high coefficient of friction, the gripping surface may protect the object's surface without damaging it. As the item moves about, so does the robotic gripper, and it must endure both of these forces in order to do its job effectively and efficiently. The following formula is used to calculate the amount of force necessary to grasp the item.

$$F = (ma/\mu n)$$

where:

- F = the force required to grip the object,
- m = the mass of the object,
- a = the acceleration of the object,
- μ = the coefficient of friction and
- n = the number of fingers in the gripper.

Including the direction of movement in the calculation would get a more accurate result. For example, if the body is pushed upwards, against gravitational pull, the force needed will be greater than the force necessary to move the body in the other direction. Thus, the formula is as follows:

$$F=[m(a+g)/\mu n]$$

The acceleration due to gravity is called g , while the acceleration due to movement is called a in this example.

4.1.2 Arduino UNO

The Arduino Uno is an open-source microcontroller board in light of the Microchip ATmega328P chip and delivered by Arduino.cc. The board has various advanced and simple input/output (I/O) pins that might be associated with an assortment of development boards (safeguards) and different circuits. Notwithstanding the 14 advanced, I/O pins and 6 simple I/O pins, the board can be modified utilizing the Arduino IDE (Integrated Development Environment), which requires a sort B USB association with interface with. There are two methods for driving it: either with a USB cable or 9 extra volt battery. It is shown in Fig 4.7.

Technical Specifications

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 can provide PWM output)
- PWM Pins: 6 (Pin # 3, 5, 6, 9, 10 and 11)[9]
- UART: 1
- I2C: 1
- SPI: 1
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA

- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g
- ICSP Header: Yes
- Power Sources: DC Power Jack & USB Port

General pin functions

- LED: There is a built-in LED powered by a digital pin 13. When the pin value is high, the LED lights up; When it's low, it's not.
- VIN: In order for the Arduino/Genuino board to receive power from an external source, it must have a VIN voltage (as opposed to 5 volts from the USB connection or other regulated power source). When using the power jack, you may use this pin to provide voltage or to access it.
- 5V: A controlled 5 volts is supplied to this pin by the on-board regulator. Power can be sent to the board via a DC socket (7-20V), USB connection (5V) or a VIN (7-20V) pin, depending on the configuration. If you supply power to 5V or 3.3V pins instead of the regulator, you run the risk of damaging the board.
- 3V3: The on-board regulator provides a 3V3 supply. 50 mA is the maximum permissible draw.
- GND: Ground pins (GND) are included.

- IOREF: On the Arduino board, the IOREF pin is used to supply the microcontroller with a voltage reference that it may use. This can be read by an appropriately setup shield. You may use voltage translators on the outputs to convert 5V or 3.3V to operate with the IOREF pin voltage.
- Reset: The reset button is often added to shields that obstruct the on-board reset button.



Fig 4.7: Arduino UNO microcontroller board

4.1.3 Bluetooth module - HC05

- It is utilised in a wide variety of consumer electronics products, including wireless headsets, gaming controllers, wireless mice, and wireless keyboards. It is shown in Fig 4.8.
- If the transmitter and receiver, atmosphere, geography, and urban circumstances are all right, the range may go up to a maximum of around 100 metres.
- A personal area network (PAN) may be built using the IEEE 802.15.1 standard protocol (PAN). To transmit data over the air, it makes use of frequency-hopping spread spectrum (FHSS) radio technology.
- It communicates with other devices through serial communication. By way of a serial port, it connects with the microcontroller (USART).

The following are the pin functions of the HC05 Bluetooth module

At command mode, a user may enter a command by pressing this key. This unit is used in command mode if the switch / EN pin is set too high. Otherwise, it will be set to data mode by default. In command mode, the HC-05's default baud rate is 38400 bps, while in data mode it is 9600 bps.

The HC-05 module may be used in two different ways.

Data mode: Mode of transferring data between electronic equipment.

Command mode: AT commands are used to alter the HC-05's settings. The module serial (USART) port is utilised to deliver these instructions.

2. VCC: Connect 5 V or 3.3 V here.

3. GND: The module's ground pin, GND.

4. TXD: Transmission of data in serial form (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. RXD: It stands for Receive Data in a Serial Format (received data will be transmitted wirelessly by Bluetooth module).

6. State: It notifies you whether the module is connected or disconnected.

HC-05 bluetooth module and a smartphone may be connected using this method:

Open the Bluetooth terminal application on your smart phone and connect to the HC-05 linked device. Simply enter in the Bluetooth terminal application on your phone to interact. Bluetooth module HC-05 will receive characters through wireless transmission. The data will be sent serially to the PC via the HC-05 and displayed on the PC's terminal. To transfer data from PC to smartphone, we may use the same method.



Fig 4.8 : HC05 bluetooth module

4.1.4 Lead Acid Battery

Brand	Amptek
Model	AT12-1.3
Product Dimensions	9.7 x 4.3 x 5.2 cm; 350 Grams
Batteries	1 Product Specific batteries required.
Item model number	AT12-1.3
Voltage	12 Volts
Battery Cell Composition	Sealed Lead Acid
Manufacturer	Amptek
Item Weight	350 g

Over the course of the battery's life, there will be no reduction in output power. Self-discharge of roughly 3% per month compared to 20%-30% for more popular battery systems. It is shown in Fig 4.9.

To guarantee a long service life, the product must be built using the best materials possible. A high discharge rate is a byproduct of low internal resistance. When fully charged, this battery has a wide working temperature range of -15°C to +50°C.. Sealed lead acid batteries, such as the 12V 1.3AH, need no maintenance. There is no loss of power throughout the battery's life. Suitable for all 'standby' applications, the valve is controlled and leak tight. 4. Self-discharge of roughly 3% per month compared to 20% to 30% for more popular battery systems. Temperature ranges from -15°C to +50°C when completely charged.



Fig 4.9: 12V 1.3Ah rechargeable Lead battery

4.1.5 SG90 servo motor

The Micro Servo Motor SG90 is a small, light, and powerful server motor as shown in Fig 4.10. Servos, which are miniature versions of regular servos, may spin around 180 degrees (90 degrees in each direction). There are no restrictions on what we can do with these servos.

Specifications

Model	SG90 servo
Size	(22.4*12.5*22.8) mm
Quiescent current	5 mA
No-load current	90mA
Pulse signal	PWM 50Hz/0.5-2.5ms
No-load speed	0.09S/60 degree@4.8V
Operating voltage range	4.8V~6.0V
Operating Temperature Range	-25 degree C to 70 degree C
Weight of motor	9 grams
Dead Band	7us
Output Shaft	4.8 mm
Stall current	750 mA
Gear type	Plastic
Net weight	10 grams
Operating speed	0.1 s/60 degrees



Fig 4.10: SG90 servo motor

4.1.6 Drone Frame

A **drone frame** is a protective suit of armor for all of the sensitive electrical components that constitutes a quadcopter as shown in Fig 4.11.



Fig 4.11 : Drone Frame for Quadcopter-X model

4.1.7 Brushed motors

You must be aware that the flight controller needs to support the type of motors you wish to use. Most micro quadcopters use brushed motors, while almost all

larger quadcopters use brushless motors. On a brushless quad, the flight controller sends a signal to the ESC. The ESC controls the speed of the motors.

In this prototype, we are using brushed motors(shown in Fig 4.12) instead of brushless motors because we are not much concentrating on speed control and instead, we are focusing on economy while building this drone prototype assembly.

As the name suggests, DC brushless motors employ brushes to commutate the motor, which in turn generates the spinning motion. The mechanical commutation function is replaced by electronic control in brushless motors. An electric motor may be brush or brushless, depending on the application.



Fig 4.12 : Brushed motors for drone*4

4.1.8 Battery and connecting wires



Fig 4.13: HW battery

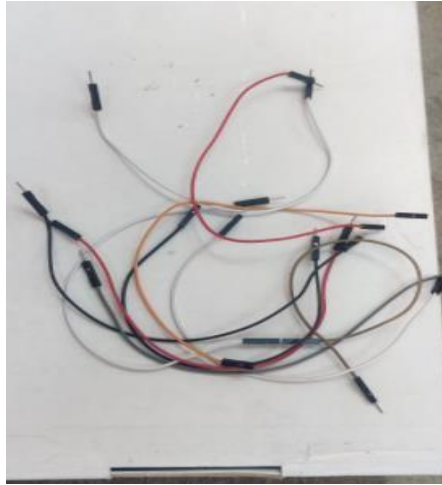


Fig 4.14: connecting wires (Arduino UNO)

4.2 METHODOLOGY

We followed the DMAIC methodology while we are undergoing this project DMAIC stands for Define, Measure, Analyze, Improve(inspect) and Control

DMAIC methodology

- **DEFINE**

Define the project goals

- **MEASURE**

Measure the process to determine current performance and quantify the problem.

- **ANALYZE**

Analyze and evaluate the solution's strengths and weaknesses.

- **IMPROVE**

Eliminate flaws and limits in the process to make it more efficient.

- **CONTROL**

Control future process performance, so that improved process doesn't degrade

As a part of the completion of the project, we designed and developed an android application to control servo motor in order to control the Gripper mechanism.

Back-end work is shown in Fig 4.15 and Fig 4.16.

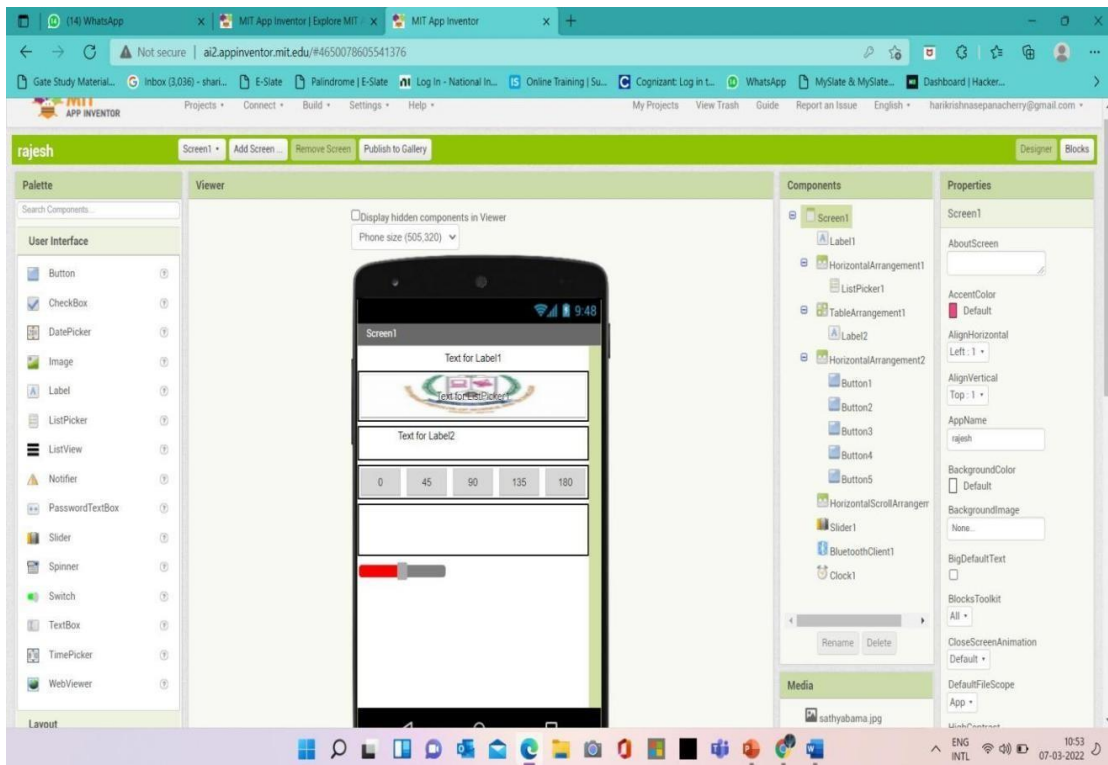


Fig 4.15 : Android Application front end development

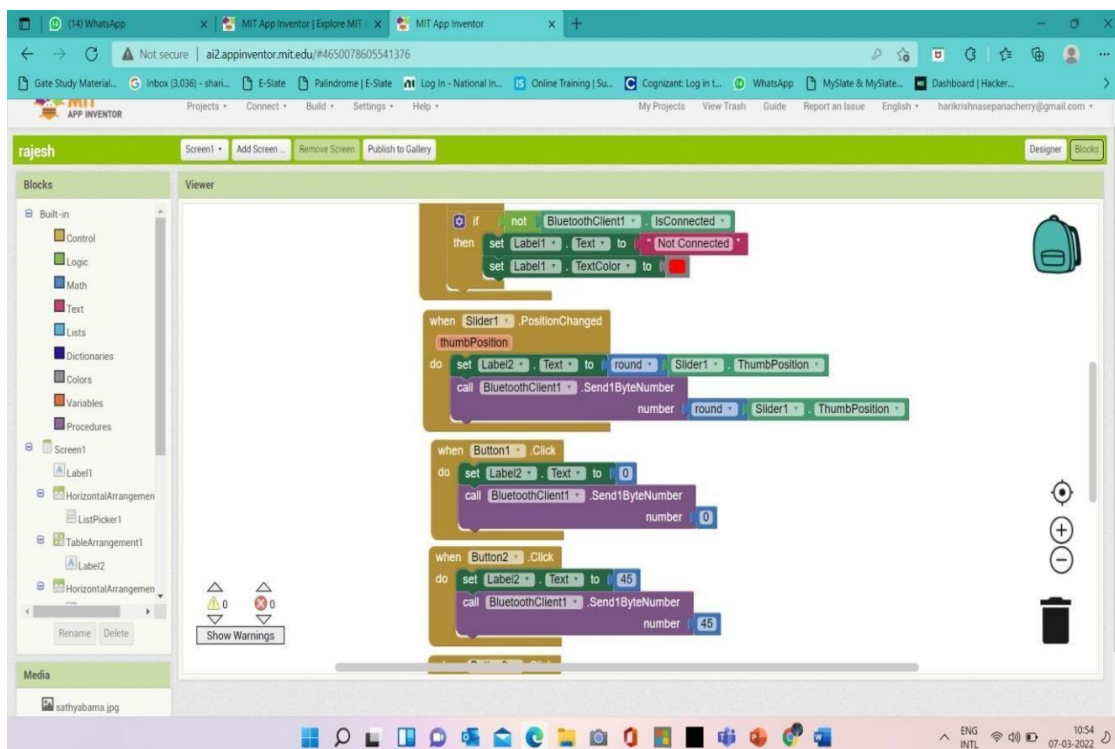


Fig 4.16: Android application back end development logic

4.3 ALGORITHM USED IN THE ANDROID APPLICATION DEVELOPMENT

We used C programming language to give our Algorithm to the Arduino UNO in order to give commands to servo motor which is connected to Gripper mechanism. The commands were sent through Android application which we can install in our Android mobiles.

The Algorithm we used is as follows:

```
#include
<SoftwareSerial.h>
#include<Servo.h>
Servo myservo;
int bttx=2; //tx of bluetooth module is connected to pin 9 of arduino
int btrx=3; //rx of bluetooth module is connected to pin 10 of arduino
SoftwareSerial bluetooth(bttx,btrx);
void setup()
{
  myservo.attach(9); // servo is connected to pin 11 of arduino
  Serial.begin(9600);
  bluetooth.begin(9600);
  myservo.write(0);
  Serial.println("SERVO
  START");
}
void loop()
{
  while(bluetooth.available()>0) // if bluetooth module is transmitting data
  {
    int pos=bluetooth.read(); // store the data in pos variable
    Serial.println(pos);
    int
    A=map(pos,0,180,0,60);
    Serial.println(A);
    myservo.write(A);
  }
}
```

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULTS

5.1.1 Design Analysis of Gripper system

Most grippers work by electric, pneumatic or magnetic mechanisms. It is one of the most common end-effectors in the Manufacturing industry. A typical gripper has 3 major components:

- Fingers (Two-fingered, Three-fingered, etc.)
- Motion source (Actuators running gears to transmit force)
- Base and other linkages

Apart from these three components there could be other components like sensors, or sometimes end-effectors are combined into one end effector.

5.1.1.1 Maximum opening of Gripper: 120mm

This engineering specification considers the opening of the gripper. The gripper opening should be large enough to load and unload the fixture-mounted workpiece. The workpiece that is considered in the given manufacturing process is 100mm in length. So 120mm should be large enough to load and unload comfortably. The minimum opening usually depends on the design of the gripper, the gripper could have fingers that are parallel, in which case the minimum opening would be 0 mm and for non-parallel fingers the minimum opening is greater than 0mm.

The max opening is calculated by measuring the length from the tip of the finger at full extension of the gears. In non-parallel finger's case the average length is taken over the opening, from tip to the end-edge of the gripper.

5.1.1.2 Calculation

$$W = m \cdot g,$$

$$W = 0.5 \cdot 9.81$$

$$W = 4.9 \text{ N}$$

$$\mu_{\text{static}} = 0.36 \text{ and } \mu_{\text{dynamic}} = 0.31$$

$$\text{So, } R_n = 4.9 \cdot 0.36 = 1.764 \text{ N (for static condition)}$$

$$R_n = 4.9 \cdot 0.31 = 1.519 \text{ N (for dynamic condition)}$$

If the safety factor is considered to be 2.

$$\text{Then design grip force} = 3.528 \cdot 2 = 7.056$$

So, approximately 7 N is the minimum grip force.

Now, considering the material strength and safety concerns by engineering assumptions the maximum grip force can be taken as 15 N. Therefore the range of grip force is 7N to 15N.

Maximum Load : 0.55 kg

This engineering specification is given to set a limit of mass of the object that the gripper can lift at held-tight state. Using the maximum grip force of 15N the max load that a fixture-mounted workpiece can be is 0.55kg. But keeping the safety factor in our view, it can be further decreased.

5.1.2 Drone specifications

The physical parameters for our example are:

RPM (n)	6100
Power (PW)	1300 W
Electrical Resistance (R)	0.22 ohm
Electric Inductance (l)	8.5 mH
Maximum Current	55 A
Moment of Inertia of the rotor (j)	0.089 kg m ²

Mechanical constant,

$$r_m = \frac{j \times 0.004 \times R}{K_e \times k_t}$$

Electrical constant,

$$T_e = I / 0.004 \times R \text{ Phase}$$

value of the EMF constant,

$$K_e = k_t \times 0.0605$$

Where k_t is torque

constant

$$\begin{aligned} \text{Torque } T &= (P_w \times 9.554) / n \\ &= (1300 \times 9.554) / 6100 \\ &= 2.03 \end{aligned}$$

Torque constant,

$$\begin{aligned} k_t &= \text{Torque} / \text{current} \\ &= 2.03 / 55 \\ &= 0.04 \end{aligned}$$

Electrical Torque,

$$\begin{aligned} K_e &= 0.04 \times 0.0605 \\ &= 0.0024 \end{aligned}$$

Mechanical constant,

$$\begin{aligned} T_m &= \frac{0.089 \times 0.004 \times 0.22}{0.04 \times 0.0024} \\ &= 0.8158 \end{aligned}$$

5.2 DISCUSSION ON WORKING AND PERFORMANCE

- The idea of cleaning debris i.e., picking up plastic waste that floats on water bodies is possible using UAV technology which is most commonly known as Drone Technology.
- Even though, practically it's possible our prototype which was built as a project product has a limitation which is nothing but the amount of scrap that it can lift up.

- It can overcome this limitation by changing the motor power output but after changing the motor power also, the drone can lift the scrap to some extent only.
- It can further more, increase it's capacity by changing the material of the drone body and the material that we used for building the Robotic arm gripper mechanism.
- It used plastic material to build both the body and gripper mechanism and as I mentioned above it can improved further by using much better and stronger with as less as weight possible. Carbon fibre material is one of the best materials available for this purpose but the only issue here is that the building cost increases as carbon fibre is costlier when compared to normal plastic material. The assembled product is shown in Fig 5.1.



Fig 5.1: Assembled Drone with Gripper mechanism

CHAPTER 6

SUMMARY AND CONCLUSION

The following points were concluded

- Drone assembled with Gripper mechanism was built and performance analysis was done practically.
- Through practical observation, it was observed that it can lift the payload upto 220 grams and can fly upto 25 minutes continuously. The flying time varies with the capacity of load while it's flying.
- With the increase in load that it's carrying, the flying time of the Drone assembly with gripper decreases.
- The working preview of the prototype is given below for the reference.

Drone prototype working video preview

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