

**DESIGN AND FABRICATION OF  
SUBMARINE FOR  
CORAL REEF MONITORING**

**MHB4336 DESIGN PROJECT IV REPORT**

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*in partial fulfilment for the award of the degree  
of*

**Bachelor of Technology**

**in**

**MECHATRONICS**



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**MAY 2024**



### **BONAFIDE CERTIFICATE**

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## ACKNOWLEDGEMENT

First and foremost, we would like to thank the Lord Almighty for his presence and immense blessings throughout the project work. It's a matter of pride and privilege for me to express my deep gratitude to the management of HITS for providing me the necessary facilities and support.

We are highly elated in expressing my sincere and abundant respect to the Vice-Chancellor **Dr. S. N. Sridhara**, for giving me this opportunity to bring out and implement my ideas in this project.

We wish to express my heartfelt gratitude to **Dr. S. Janaki Raman**, Associate Professor and HoD (i/c), **Department of Mechatronics Engineering** for much of his valuable support and encouragement in carrying out this work.

We would like to thank our guide, **Mr. V. Ram Kumar**, Assistant professor, **Department of Mechatronics Engineering** for continually guiding and mentoring us by giving valuable suggestions to complete the projectwork.

We are exceptionally obligated to our project coordinators **Mr. V. Ramkumar** for their direction and steady supervision throughout our project. We would like to thank all the technical and teaching staff, the **Department of Mechatronics Engineering** for all the support.

Last, but not least, my thanks and thanks additionally go to my partners in building up the venture and individuals who have energetically gotten me out with their capacities. We are deeply indebted to my parents who have been the greatest support throughout the project.

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## **ABSTRACT**

A simple submarine model for coral reef monitoring which is a manually operated vehicle and uses three types of sensors for monitoring the water in the coral reef ecosystem is presented in this paper. Coral reefs play a crucial role in the marine ecosystem by serving as a habitat for a wide range of marine species and supporting the livelihoods of coastal communities. Nevertheless, these delicate ecosystems are currently facing unparalleled challenges due to climate change, pollution, and human activities. It is crucial to implement effective monitoring and conservation measures to ensure the preservation of the health and diversity of coral reefs. The manually operated submarine is capable of navigating in the water, measuring and collecting data of TDS level of water, temperature of water and pressure at the water various levels of water. For monitoring the collected data, we are using a Micro SD card module to store the collected data so that we can observe the data after getting out the submarine from water. Submarine is controlled using Raspberry pi 4.

### **Keywords:**

Coral reef monitoring, Movement of submarine, Water level monitoring, Raspberry pi 4

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# **CHAPTER 1**

## **INTRODUCTION**

Coral reefs, commonly known as the "rainforests of the sea," are highly diverse and essential ecosystems on Earth. These underwater marvels are home to a wide range of marine life and play a crucial role in maintaining the ecological balance of our oceans. However, coral reefs are currently facing unprecedented challenges such as climate change, ocean acidification, pollution, and overfishing, which pose a significant threat to their existence. To address these critical issues and ensure the survival of these valuable marine habitats, innovative and technologically advanced solutions are required.

This introduction sets the stage for exploring one such solution: the Submarine for Coral Reef Monitoring (SCRM). Coral reefs are unique ecosystems that provide a habitat for approximately 25% of all marine species, despite covering only a small portion of the ocean floor. Their contribution to marine biodiversity, fisheries, and tourism is immeasurable. Additionally, they serve as natural barriers, safeguarding coastal communities from the destructive impacts of storms and erosion. Given their ecological, economic, and cultural importance, it is crucial that we take meaningful actions to preserve and protect coral reefs. While traditional methods of coral reef monitoring have provided valuable insights into their condition, they often have limitations in terms of scope, precision, and timeliness. Researchers and conservationists have been in search of a more advanced and efficient approach to studying these ecosystems.

This is where the Submarine for Coral Reef Monitoring comes into play. The SCRM represents a groundbreaking innovation in marine technology, offering a promising solution to comprehensively monitor and evaluate coral reef health, biodiversity, and environmental conditions with unparalleled precision and minimal disruption. Coral reefs play a crucial role in the marine ecosystem by serving as a habitat for a wide range of marine species and supporting the livelihoods of coastal communities. Nevertheless, these delicate ecosystems are currently facing unparalleled challenges due to climate change, pollution, and human activities.



Coral reefs checking incorporates the exact insight and assessment of coral reef organic frameworks to get a handle on their prosperity, components, and responses to regular changes. Coral reefs are significantly unique and complex marine conditions that offer basic normal sorts of help, including living space for different marine species and protection for shores. Noticing these organic frameworks is dire for studying their condition, recognizing risks, and completing strong assurance and the board methods. Here is a brief introduction to coral reefs noticing:

#### **1.1.1 Purpose of Monitoring:**

Natural Health: Noticing reviews the overall strength of coral reef natural frameworks by investigating components like coral cover, species assortment, and people components of key natural substances.

Normal Changes: Noticing tracks changes in biological conditions, similar to sea temperature, water quality, and ocean maturation, to sort out their impact on coral reefs.

#### **1.1.2 Key Limits Monitored:**

Coral Cover: The level of living coral on the reef.

Biodiversity: The combination and flood of different species, including corals, fish, and cowardly animals.

Coral Bleaching: Noticing for signs of pressure started coral biting the dust, every now and again associated with raised sea temperatures.

Water Quality: Limits like temperature, pungency, supplement levels, and sedimentation rates.

Human Activities: Noticing the impact of human activities like fishing, the movement business, and waterfront enhancement for coral reef conditions.

#### **1.1.3 Monitoring Techniques:**

Distant Sensing: Satellite and airborne imagery give huge degree examinations of coral reef conditions, recalling coral blurring events and changes for reef structure.

Lowered Surveys: Jumpers and remotely worked vehicles (ROVs) lead organized assessments of coral prosperity, biodiversity, and substrate structure.

Data Logging Instruments: Robotized instruments measure limits like temperature, pungency, and supplement levels after some time.

Occupant Science: Remembering general society for data grouping, regularly through inhabitant science programs, can give significant information on coral reefs over immense

geographic locales.

**1.1.4 Threat Identification:** Checking recognizes and assess threats to coral reefs, for instance, ecological change, overfishing, tainting, and region destruction. Early area of coral ailments, prominent species, and coral blurring events is critical for completing ideal conservation measures.

**1.1.5 Conservation and Management:** The data assembled through noticing projects enlighten conservation and the leaders decisions, including the groundwork of marine defended districts, improvement of reasonable fishing practices, and control of natural change impacts.

**1.1.6 Global Initiatives:** Coral reef noticing is commonly important for overall drives and composedendeavors, for instance, the Overall Coral Reef Really taking a look at Association (GCRMN) and the Coral Reef Noticing for The board (CREMMA) structure, which mean to standardize noticing procedures and proposition data generally. Coral reefs noticing is basic for getting a handle on the incredible components of these organic frameworks, coordinating insurance tries, and raising legitimate organization practices to ensure the long prosperity and strength of coral reefs all over the planet. Coral reefs are used in our regular day to day existences in different ways, including:

**Food:** Coral reefs give a food source to a considerable number of people all around the planet. Fish, shellfish, and other marine life that depend upon coral reefs are critical wellsprings of protein and food for certain people.

**Waterfront protection:** Coral reefs go probably as typical deterrents that safeguard shores from storms and breaking down. By diminishing the wave energy that shows up at the coast, coral reefs can help with preventing mischief to property and structure.

**The movement business and recreation:** Coral reefs are notable traveler areas, and numerous people value practices like plunging, swimming, and fishing in coral reef districts. Coral reefs moreover give financial benefits to neighborhood networks through the movement business related positions and associations.

**Medicine:** Specialists are developing new meds from coral reef life structures to treat various disorders, including threatening development, joint aggravation, and contaminations.

**Jewelry:** Coral is occasionally used to make enhancements, similar to accessories, wristbands, and loops. Despite these prompt purposes, coral reefs similarly play different huge indirect positions in our lives. For example, coral reefs help to stay aware of sound sea life natural frameworks, which are essential for supporting fisheries and other marine endeavors. Coral reefs

similarly help to control the climate and to give a living space to a wide grouping of marine life.

The following are a couple of express occurrences of how coral reefs are used in our regular day to day existences:

Fishery products: countless the fish and shellfish that we eat come from coral reefs. These integrate notable fish things like fish, shrimp, and lobster.

Shoreline protection: Coral reefs help to safeguard ocean front organizations from storms and deterioration. For example, the Exceptional Prevention Reef in Australia is evaluated to defend \$6 billion in ocean facing land consistently.

Tourism: Coral reefs are a huge place to get-away, and numerous people value practices like bouncing, swimming, and fishing in coral reef districts. Coral reef the movement business makes billions of dollars in pay consistently and upholds countless occupations all over the planet.

Medicine: Analysts are developing new meds from coral reef animals to treat various diseases. For example, a medicine got from a coral reef wipe is being used to treat sickness.

Coral reefs are significant for the thriving of billions of people all around the planet. We ought to do everything we possibly can for defend these principal organic frameworks for individuals later on.

### **1.1 Objective of The Project:**

A simple submarine model for coral reef monitoring which is a manually operated vehicle and uses three types of sensors for monitoring the water in the coral reef ecosystem is presented in this paper. Coral reefs play a crucial role in the marine ecosystem by serving as a habitat for a wide range of marine species and supporting the livelihoods of coastal communities. Nevertheless, these delicate ecosystems are currently facing unparalleled challenges due to climate change, pollution, and human activities. It is crucial to implement effective monitoring and conservation measures to ensure the preservation of the health and diversity of coral reefs. The manually operated submarine is capable of navigating in the water, measuring and collecting data of TDS level of water, temperature of water and pressure at the water various levels of water. For monitoring the collected data we are using a Micro SD card module to store the collected data so that we can observe the data after getting out the submarine from water. Submarine is controlled manually.

## **CHAPTER 2**

### **LITERATURE REVIEW**

Coral reefs are incredibly biodiverse and human reliance on their biological system administrations is high. Reefs experience critical immediate and backhanded anthropogenic tensions, and give a delicate sign of beach front sea wellbeing, environmental change, and sea fermentation, with related ramifications for society. Observing coral reef status and patterns is crucial for better illuminate science, the board and strategy, however the extended breakdown of reef frameworks inside years and years makes the arrangement of precise and significant checking information earnest. The Worldwide Coral Reef Checking Organization has been the establishment for worldwide covering coral reefs for a very long time, and is going into another stage with worked on functional and information norms consolidating the Fundamental Sea Factors (EOVs) ([www.goosocean.org/eov](http://www.goosocean.org/eov)) and Structure for Sea Noticing created by the Worldwide Sea Noticing Framework. Three EOVs give a strong depiction of reef wellbeing: hard coral cover and organization, full scale algal overhang cover, and fish variety and overflow. An information quality model in light of far reaching metadata has been intended to work with greatest worldwide inclusion of coral reef information, and substantial moves toward track limit building. Further developed observing of occasions like mass fading and illness flare-ups, resident science, and financial checking can possibly significantly work on the pertinence of checking to administrators and partners, and to address the complex and multi-layered cooperations among reefs and individuals. [1].

Coral reefs are in decline overall and checking exercises are significant for surveying the effect of aggravation on reefs and following ensuing recuperation or decline. Observing by field studies gives exact information yet at exceptionally limited scales as isn't financially savvy for reef scale checking at continuous time focuses. Remote detecting from satellites is another option and correlative methodology. While remote detecting can't give the degree of detail and exactness at a solitary point than a field review, the factual power for deducing enormous scope designs benefits in having total areal inclusion. This audit considers the cutting edge of coral reef remote detecting for the assorted scope of goals important for the executives, going from the structure of the reef: actual degree, benthic cover, bathymetry,

rugosity; to natural boundaries: ocean surface temperature, openness, light, carbonate science. As well as refreshing past audits, here we likewise consider the ability to go past fundamental guides of territories or ecological factors, to talk about ideas profoundly pertinent to partners, strategy producers and public correspondence, for example, biodiversity, natural danger and environment administrations. A reasonable finish of the survey is that advances in both sensor innovation and handling calculations keep on driving forward remote detecting capacity for coral reef planning, especially regarding spatial goal of guides, and union across different information items. The two patterns can be anticipated to proceed. [2].

Coral reefs have probably the most elevated groupings of biodiversity and financial worth in the seas, yet these biological systems are under danger because of environmental change and other human effects. Reef observing is regularly used to assist with focusing on reefs for preservation and assess the progress of mediation endeavors. Reef status and wellbeing are most often described utilizing jumper based reviews, however the innate restrictions of these strategies mean there is a developing requirement for cutting edge, normalized, and robotized reef procedures that catch the complicated idea of the environment. Here we draw on encounters from our own interdisciplinary examination projects to depict progresses in situ jumper based and independent reef checking. We present our vision for coordinating interdisciplinary estimations for select "contextual investigation" reefs overall and for learning designs inside the natural, physical, and synthetic reef parts and their communications. At last, these endeavors could uphold the improvement of a versatile and normalized set-up of sensors that catch and transfer key information to help with ordering reef wellbeing. This system can possibly give partners the data important to survey reef wellbeing during an extraordinary season of reef change as well as reclamation and mediation exercises[3].

The coral reef environments of Nanwan Sound, Southern Taiwan are going through corruption because of anthropogenic effects, and as such have brought about a decrease in coral cover. As an initial phase in forestalling the ceaseless debasement of these coral reef conditions, it is essential to comprehend what changes in water quality mean for these biological systems on a calibrated timescale. To this end, an ongoing water quality observing framework was carried out in Nanwan Cove in 2010. We tracked down that normal occasions, for example, chilly water interruption due to upwelling, would in general evoke transient changes in coral

producing somewhere in the range of 2010 and 2011. Moreover, Degree Warming Weeks (DHWs), a normally used indicator of coral fading, were 0.92 and 0.59 in summer 2010 and 2011, separately. However this amount of DHW was beneath the assumed pressure prompting an incentive for these reefs, an ascent in DHWs in the future might pressure the occupant corals [4]

Environment checking is fundamental to powerful administration, where quick revealing is fundamental to give convenient exhortation. While computerized symbolism has extraordinarily worked on the speed of submerged information assortment for checking benthic networks, picture examination stays a bottleneck in detailing perceptions. As of late, a quick development of man-made consciousness in picture acknowledgment has been clear in its wide applications in current culture, offering new open doors for expanding the capacities of coral reef observing. Here, we assessed the presentation of Profound Learning Convolutional Brain Organizations for computerized picture examination, utilizing a worldwide coral reef observing dataset. The review shows the upsides of mechanized picture examination for coral reef observing with regards to mistake and repeatability of benthic overflow assessments, as well as cost and advantage. We tracked down unprejudiced and high arrangement among master and robotized perceptions (97%). Rehashed reviews and examinations against existing checking programs additionally show that mechanized assessment of benthic creation is similarly strong in identifying change and guaranteeing the congruity of existing observing information.

Utilizing this computerized approach, information examination and revealing can be advanced by something like 200x and for a portion of the expense (1%). Consolidating normally involved submerged symbolism in observing with robotized picture comment can emphatically further develop how we measure and screen coral reefs around the world, especially as far as dispensing restricted assets, fast revealing and information combination inside and across the executives region [5].

Coral dying has been thought of as one of the significant supporters of the expanded around the world crumbling of coral reef environments being accounted for throughout the course of recent many years. Naturally the requirement for worked on figuring out, checking, and expectation of coral bleaching becomes basic. Satellite remote detecting has turned into a critical instrument for coral reef supervisors what's more, researchers, giving the ability of

succinct perspectives of the worldwide seas in close continuous and the capacity to screen remote reef regions. As soon as 1997, NOAA's Public Natural Satellite, Information, and Data Administration (NESDIS) started creating close continuous, webaccessible, satellite-determined ocean surface temperature (SST) items to screen conditions helpful for coral dying from warm pressure all over the planet. In 2000, this action empowered the beginning of NOAA's Coral Reef Watch (CRW) Program. Over the recent years, a large portion of its key items, including SST inconsistencies, fading Areas of interest, Degree Warming Weeks (DHW), and Tropical Sea Coral Dying Records website page became "functional" items after effectively giving early admonitions of coral fading to the U.S. also, worldwide coral reef networks as "trial" items for a very long time. Right now, a few new nearreal-time items, including Momentary Patterns of Warm Pressure, Span of Warm Pressure, Number of Stress Days, and a computerized email cautioning framework, are in the last transformative phases and ought to turn into accessible soon. As we endeavor to work on the precision of the checking items and foster forecast abilities, CRW is trying to foster these items at higher spatial goals, screen other related ecological boundaries (like surface breeze, sun oriented radiation, and wave field), integrate mathematical model recreations, and grow new and more precise calculations.

CRW's central goal is to give the homegrown what's more, worldwide coral reef networks with convenient and precise data for figuring out, checking, and saving these "rainforests of the ocean"[6].

Coral reef observing projects exist in all locales of the world, recording reef credits like coral cover, fish biomass and macroalgal cover. Given the expense of such checking programs, and the debased condition of a significant number of the world's reefs, understanding the way in which reef observing information can be utilized to shape the executives choices for coral reefs is a high need. In any case, there is no broad manual for understanding the biological ramifications of the information in a configuration that can set off an administration reaction. We endeavor to give such a manual for deciphering the fleeting patterns in 41 coral reef observing traits, recorded by seven of the biggest reef checking programs. We show that main a little subset of these traits is expected to recognize the stressors that have influenced a reef (for example give a conclusion), as well as to gauge the possible recuperation potential (guess). Two of the most valuable pointers, turf algal shelter level and coral province development rate are not ordinarily estimated, and we firmly suggest

their consideration in reef observing. The determination and visualization framework that we have created may assist with directing administration activities and gives an establishment to additional improvement as natural and environmental bits of knowledge keep on developing[7].

Coral reef checking is a solid device to survey the impact of environmental change as corals are delicate to expansions in water temperatures between 30 °C and 35 °C bringing about fading - a brightening cycle when the corals lose their variety and the reefs start to kick the bucket. Existing satellite-based checking items work with coral bleaching observing over huge spatial scales, yet their utilization in anticipating nearby scale pressure that impacts the fading seriousness across reefs is restricted. In this paper, we portray a Fixed Reef Observing Framework (SRMS) that screens the time development of coral reefs through the photography of neighboring coral bunches. All the while, the SRMS measures and records natural boundaries like temperature, sunlight based irradiance (Standard), and saltiness in the waters encompassing the coral provinces. At the point when sent in the ocean, the SRMS identified a 0.1-0.4 °C fluctuation in temperature between the in situ and satellite datasets.

The SRMS utilizes variety photography alongside quantitative information on natural boundaries to screen the soundness of corals and disposes of the requirement for physical/visual check of coral wellbeing by a jumper. By this methodology, one can decide the pressure limits of corals and distinguish the powerless and strong reefs to focus on protection endeavors[8].

Environmental change is influencing all biological systems on the planet, mechanical technology applications are zeroing in on observing environments impacts. Coral reef in Honduras is a significant asset that should be saved. This study shows the improvement of a robot for observing coral reef, working on certain difficulties of submerged mechanical robot plan. The robot improvement executes VDI 2206 model into cycles the lab plan and the model reconciliation. As a result of various power assessments, recreations and field test the robot achieve its undertaking. PWM yields control the power push. Inside sensors for holes and temperature guarantee the robot capabilities. The vision framework identify movement to take recordings and photographs at regular intervals. Ocean water temperature, recordings, and photographs are put away in a minicomputer. The stream reenactment guarantees robot mechanical plan to achieve its undertaking. The control ought to be improve adding a numerical model for the robot uprooting submerged[9].



Coral species discovery submerged is a difficult issue. There are many situations when even the specialists (sea life scholars) neglect to perceive corals, consequently restricting ground truth comment for preparing a strong recognition framework. Recognizing coral species is basic for empowering the observing of coral reefs, an undertaking as of now performed by people, which can be mechanized with the utilization of submerged robots. By utilizing fleeting signs utilizing a tracker on a high certainty expectation by a convolutional brain network-based object indicator, we increase the gathered dataset for the retraining of the item locator. In any case, utilizing trackers to extricate models likewise presents hard or mislabelled tests, which is counterproductive and will break down the exhibition of the locator. In this work, we show that utilizing a straightforward profound brain organization to sift through hard or mislabelled tests can assist with controlling example extraction. We observationally assess our methodology in a coral item dataset, gathered through an Independent Submerged Vehicle (AUV) and human jumpers, that shows the advantage of consolidating separated models got from following. This work likewise shows how controlling example age by following utilizing a straightforward profound brain organization can additionally further develop an item finder[10].

Given expected developments in urbanization in tropical and subtropical areas, understanding the cycles shaping metropolitan coral reefs may be principal for expecting future security challenges. We used a relevant examination method for managing perceive uniting instances of metropolitan coral reefs and make sense of the effects of urbanization on hard coral get-togethers. Data were assembled from 11 metropolitan networks generally through East and Southeast Asia, with explicit focus on Singapore, Jakarta, Hong Kong, and Naha (Okinawa). Our overview includes a couple of essential characteristics of metropolitan coral reefs, including "reef pressure" (a reduction in bathymetric reach with growing turbidity and lessening water clarity after a few time and near with shore), strength by domed coral improvement designs and low reef complexity, variable city-express inshore- toward the ocean slants, early declines in coral cover with late fluctuating seasons of extraordinary impacts and speedy recovery, and colonization of metropolitan establishment by hard corals. We present hypotheses for metropolitan reef neighborhood and look at capacity of normal planning for corals in metropolitan areas [11].

The economical administration of waterfront and seaward biological systems, such as

coral reef conditions, requires an energy productive assortment of precise information across different fleeting and spatial scales. To reasonably address the energy supply of marine sensors, in this paper an original energy gathering gadget is proposed, in view of a Cylindrical Long-lasting MagnetLinear Generator (TPM-LiG). The application is connected with the ocean wave energy transformation for little sensorized float. The improvement cycle is created through transformative calculation methods. The benefit of these calculations is in the wide investigation of the factors space and in the viable double-dealing of the wellness capability. The calculation has been tried on a benchmark case and afterward applied to the improvement of a power-float model which has been acknowledged in research facility with likely critical ramifications in future marine climate applications[12].

We have been fostering a remote sensor network framework to help coral biological framework overview exercises. This paper concentrates on the necessary elements of a remote sensor hub for get-together data on submerged natural circumstances. For this reason, a model sensor hub is created to explain vital capabilities through a down to earth explore. In this paper, the equipment design of a most recent model of remote sensor hub is depicted. The plan of this model depended on our past trials and the remarks of coral reef analysts. We directed pragmatic field tests to notice the coral reefs along the Okinawa coast in Japan by utilizing the model. Besides, a perusing arrangement of assembled data by the sensor network is portrayed. At last, we examine the exploratory outcomes and the expected elements of the sensor hub for the future examination[13].

Coral reefs are among the most useful and various biological systems on the planet and give a huge number of significant environment administrations. Also, the assets got from coral reefs are vital for the food security of millions of individuals living inside tropical beach front networks. Tragically, thriving human populaces in waterfront locales are putting an unreasonable weight on these assets with the end goal that corruption of coral reefs is normal. Moreover, during 1998, El Niño driven expansions in ocean temperature caused a mass fading occasion that further debased a significant number of the world's coral reefs. This article gives a short survey of the situation with the world's coral reefs and features their worth to society. Likewise, the anthropogenic and regular unsettling influences that undermine the fate of coral reefs are talked about lastly, this article offers a few potential cures that advance practical utilization of coral reef assets subsequently guaranteeing their future endurance[14].

With coral cover and variety declining on numerous coral reefs, a clexer understanding

of enormous scope reef elements is basic. This paper presents a sampling program intended to evaluate the sessile biotas of Caribbean reefs on huge spatiotemporal scales. For each reef inspected, information are accumulated along duplicate, 25-m cuts across situated inside the territory of interest. Herbivore influence is assessed by fish and echinoid censuses along the cuts across. High-goal tapes are utilized to assess the percent front of corals, green growth, and other foundation inhabitants, and to assess coral variety. At long last, geographical intricacy is estimated along the cuts across. In some reef territories in any event, this record of three-layered structure gives a proportion of the all out unsettling influence system, with compliment regions having been exposed to more serious, more continuous, as well as later wellsprings of coral mortality. The strategies and factual investigations portrayed in this paper are straightforward, fast and modest. Continued testing on various reefs will empower the examiner to identify changes in local area structure and to test speculations of the reasons for those changes [15].

The degree of the Reef Check program has changed as it has created. The program was at first arranged as a one-time assessment of coral reef prosperity on an overall scale using gatherings of brandishing jumpers arranged and drove by an ocean life specialist (Hodgson, in press). The one of a kind thought was for gatherings to be conveyed at the same time at numerous objections around the world and to use a common survey system to be careful with the circumstance with coral reefs. In 1997, the "window" for not set in stone to be 2.5 months, while in 1998, the open period was stretched out to a half year. Beginning in 1999, studies can be finished at whatever point. By the completion of 1998, well a greater number of than 400 reefs had been outlined in 40 countries and districts all around the planet by many donning jumpers, inhabitants, and analysts. The strategies were successfully embraced by a wide combination of clients including government and non-government checking and the chiefs programs in both making and made countries. Furthermore in 1998, the Overall Coral Reef Noticing Association (GCRMN) was formally associated with Reef Check, and GCRMN picked the Reef Check procedures for its neighborhood noticing work. Subsequently the best usage of the Reef Check techniques has been broadened, and a couple of changes are supposed to meet these new purposes. There will not at any point be an "ready to move" long stretch noticing project. Each region has express necessities and resources that will require an extraordinarily make. The necessity for state run organizations to finish long stretch checking of coral reefs has been postponed to be perceived, even in made countries.

Regardless, as extra solitary exercises and governing bodies have decided to set up coral reef noticing projects, a "leaned toward plan framework" has emerged (Hodgson, this strategy). In regions like Western Australia and the Florida Keys, where coral reef noticing projects are progressed, it is becoming clear that the ideal model will incorporate something like two levels of checking: a communitybased, to some degree extensive brush noticing project did by gatherings of scientists and neighborhood for instance Reef Check, and a significant standard program finished by pure consistent gatherings. In the north of two regions, and various others, Reef Check has become some piece of a completely inspected, high level, staggered checking program that is useful at neighboring, commonplace and overall scales. The program has worked splendidly with jumpers from neighborhood networks and with the overall neighborhood voyager jumpers. In a stunned noticing framework Reef Really take a look at plays a couple of parts. In any case, it is a modestly speedy procedure, that allows a gathering to collect a portrayal of the sufficiency of reef corals, other cowardly animals and fish at up to two areas every day. As extra regions are outlined in a particular district, the objective of the portrayal is extended. Since Reef Check relies upon major commitments from volunteers, with honest government and NGO support, Reef Really investigate gatherings can be ready to concentrate on a ton a more noteworthy number of districts than is possible with extra thought procedures which are extensively more extravagant in time, staff and sponsoring. As such, the "ideal" two-level noticing undertaking would have two or three significant standard objections using procedures, for instance, English et al., and a greater number of lower objective Reef Truly take a gander at regions In development, the Reef Check districts can be resurveyed more as frequently as conceivable than the significant standard areas. Routinely, significant standard coherent outlines are done once, or likely, twice every year. If Reef Check studies are repeated at quarterly ranges, they can go about as an early caution structure for major anthropogenic changes, for instance, whitening, influence or poison fishing, overfishing, eutrophication and sedimentation. The second occupation of Reef Check is to foster neighborhood for a coral reef checking and the board program in each space. Without such assistance, even well- upheld government-drove the leaders attempts will miss the mark. By partaking in Reef Check planning, fund-raising, and outlines, neighborhood encourage a sensation of stewardship towards the reefs they are noticing. For what reason is this particularly critical philosophical change is that it could incorporate monetary subject matter experts, government authorities, specialists, etc. These

are people who may not at first have had a particularly amazing interest in security, and who can then spread their educational experience all through society. There moreover are tremendous remunerations for scientists who volunteer to help with setting up the audit gatherings. By tracking down a valuable open door to explain for people from the public why coral reefs are huge, specialists can show why coral reef science and nature overall, are huge pursuits. While various scientists are at this point drew in with a neighborhood some sort or another tutoring, others are not. This sort of coordinated effort produces public assistance for coral reef science and for scientists who do fundamental investigation[16].

Microorganisms make a huge commitment to reef environment wellbeing and flexibility by means of their basic job in interceding supplement changes, their communications with large scale creatures and their arrangement of compound prompts that support the enlistment of different reef taxa. Notwithstanding, ecological changes frequently cause compositional and utilitarian changes in microbial networks that can have stream on ramifications for microbial-interceded processes. These microbial changes might influence the wellbeing of explicit host creatures and can have repercussions for the working of whole coral biological systems. Evaluating changes in reef microbial networks ought to accordingly give an early mark of biological system influences and would support the advancement of demonstrative devices that could end up being useful to figure shifts in coral reef wellbeing under various ecological states. Observing, the executives and dynamic rebuilding endeavors have as of late escalated and expanded because of worldwide decreases in coral reef wellbeing. Here we suggest that ordinary checking of coral reef microorganisms could give a quick and touchy stage for recognizing declining biological system wellbeing that can supplement existing administration structures. By summing up the most widely recognized dangers to coral reefs, with a specific spotlight on the Incomparable Obstruction Reef, and expounding on the job of microorganisms in coral reef wellbeing and biological system steadiness, we feature the demonstrative materialness of organisms in reef the executives programs. Central to this goal is the foundation of microbial baselines for Australia's coral reefs[17].

## CHAPTER 3

### METHODOLOGY

#### 3.1 Introduction:

This chapter explains about the step-by-step process starting from design to Prototype of the project.

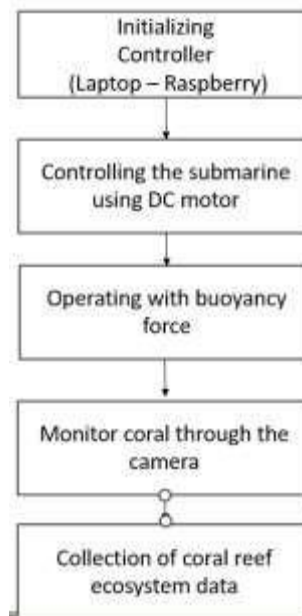


Fig 3.1 methodology flow chart of the submarine

#### 3.2 Chassis Design in Solid Works:

A set of designs were designed for the chassis and at last a design was finalized. Then the chassis of the submarine was designed as separate pieces and fixed together in the solid works software and the material properties were added to it. The chassis is done using the syringes, threaded rods, acrylic sheet, pvc pipes joined along with the dc motors, pump motors and gear motor.

### 3.3 Block Diagram of Submarine:

The block diagram will be able to help us understand about the functioning and working of the submarine.

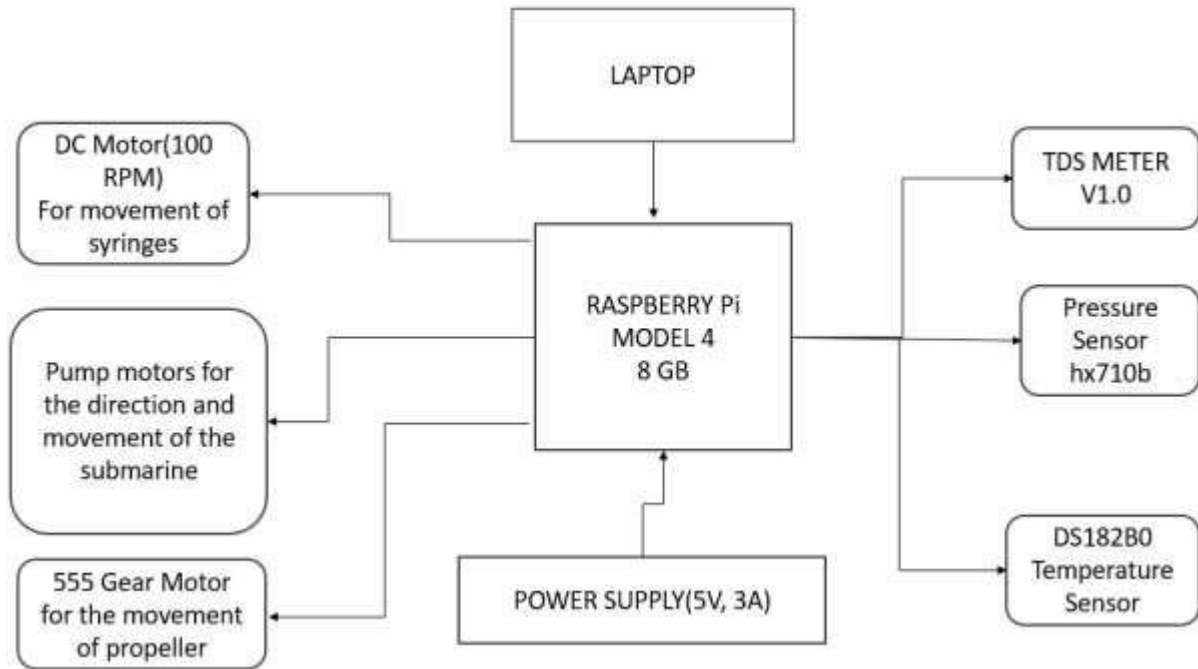


Fig 3.2 Block Diagram of the Submarine

### 3.4 Circuit Designing:

The circuit designing was done in fritzing, the circuit consists of 2 DC motors [300 R.P.M] are used to run the motor for the buoyancy movement from the syringes, consists of two pump motors for the for the pumping of water for the movement control of the submarine, and consists a propeller fan for the forward movement of the submarine, the whole circuit is for movement of the submarine, And ecosystem sensing sensors mainly (TDS Sensor, HX710B Pressure sensor, DS182B0 temperature sensor) which are used respectively for measuring ‘total dissolved solids’, ‘Pressure’, ‘Temperature’ of the water in the coral reef ecosystem.





was laser cutted according to the dimensions done in solid works. Motor and syringe housing was done according to the shape of the acrylic with the help of basic mechanical machinery such as lathe and drilling machine. The connection of the acrylic sheets on both sides along with the components is done using the threaded rods. Banner glue was used on the top of the housing for attaching it to the acrylic sheet. For the direction and movement of the submarine pump motors are used attached alongside the submarine body. The whole body of the submarine is shielded and covered with PVC Pipes to restrict the water from going inside the submarine. End caps are used to cover the ends of the submarine for movement of the submarine under water.

## CHAPTER:4

### COMPONENTS SELECTION

#### 4.1 DS18B20 water proof temperature sensor:

DS18B20 waterproof temperature sensor, which is a well-known temperature sensor produced by Proverb Incorporated. The DS18B20 is known for its exactness and usability, and its waterproof variant is much of the time utilized in applications where the sensor should be drenched in fluids or presented to cruel natural circumstances. Here are a few vital elements of the DS18B20 waterproof temperature sensor, the temperature reach of DS18B20 is in the scope of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  ( $-67^{\circ}\text{F}$  to  $+257^{\circ}\text{F}$ ). Precision has an ordinary exactness of  $\pm 0.5^{\circ}\text{C}$  over the scope of  $-10^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ . Computerized result of DS18B20 gives an advanced result, which improves on the connecting with microcontrollers. One-Wire Connection point utilizes a one-wire interface, implying that different sensors can be associated with similar information line, working on the wiring in multi-sensor arrangement. The waterproof rendition of the DS18B20 arrives in a treated steel tube that makes it reasonable for use in fluids and other unforgiving conditions. Power Supply works on an extensive variety of force supplies, ordinarily somewhere in the range of 3.0V and 5.5V. The sensor gives a client configurable goal, going from 9 to 12 pieces. To utilize the DS18B20 waterproof temperature sensor, you commonly associate it to a microcontroller or a solitary board PC (like Arduino or Raspberry Pi) utilizing its one-wire interface.



Fig 4.1 DS18B20 Temperature Sensor

## 4.2 TDS Sensor:

A TDS (Total Dissolved Solids) sensor (TDS Meter V1.0) is a gadget intended to gauge the grouping of all out broke up solids in an answer, commonly water. It is usually utilized in water quality testing, hydroponics, tank-farming, and different applications where checking the centralization of broken up substances is significant. TDS sensors work in light of the rule of electrical conductivity. The conductivity of an answer is impacted by the presence of particles, which are the broken-up solids in the water. As the centralization of broken up solids builds, the electrical conductivity of the arrangement additionally increments. TDS sensors frequently comprise of a test or sensor that is drenched in the answer for be tried. The test contains cathodes or sensors that action the electrical conductivity of the arrangement. TDS is usually estimated in parts per million (ppm) or milligrams per liter (mg/L). The sensor offers a mathematicalbenefit addressing the grouping of broken up solids in the water. TDS sensors might require occasional alignment utilizing standard arrangements with realized TDS values. Alignment guarantees the exactness of the sensor's readings. Some TDS sensors accompany a computerized show that shows the deliberate TDS esteem straightforwardly. Others might furnish simple result or discuss carefully with a different showcase or information logging gadget. The conductivity of water is temperature-subordinate. High level TDS sensors might incorporate temperature pay elements to give exact readings across a scope of temperatures. TDS sensors are utilizedin different applications to screen water quality. High TDS levels might demonstrate thepresence of salts, minerals, metals, and other broke down substances.



Fig 4.2 TDS Meter V1.0

### 4.3 HX710B Pressure Sensor:

The HX710B is a precision 24-bit analog-to-digital converter (ADC) designed for weighing scales and other applications that require high accuracy in measuring small changes in resistance. It is often used in conjunction with load cells for weight sensing. The HX710B is known for its high precision, offering 24-bit ADC resolution. This allows for accurate measurement of small changes in resistance, making it suitable for applications where precise weight measurements are required. It is designed to interface with load cells, which are transducers that convert force or weight into an electrical signal. The HX710B can amplify and digitize the signals from load cells. The HX710B typically communicates with microcontrollers or other devices through serial communication protocols like I2C or SPI (Serial Peripheral Interface). This makes it compatible with a wide range of microcontroller platforms. To ensure accurate measurements, the HX710B is designed to have low noise in its analog-to-digital conversion process. This is crucial for obtaining stable and reliable weight readings. It often supports calibration procedures to compensate for any inaccuracies or variations in the measurement setup. Calibration allows users to fine-tune the system for optimal accuracy. The HX710B is usually designed in a compact form factor, suitable for integration into various electronic systems and devices.



Fig 4.3 HX710B Pressure sensor

#### 4.4 DIRECT CURRENT MOTOR:

DC engines are ordered in light of their speed, force, and power rating. The construction of a DC motor and the voltage that is applied to it determine its speed. The motor will rotate more quickly the higher the voltage applied to it. A DC motor's torque is the amount of rotational force it can produce and is determined by the motor's current. The maximum amount of electrical power that a DC motor can handle is known as its power rating, and it is typically expressed in watts. Batteries, power supplies, and motor controllers are some of the power sources that can be used to power a 300 RPM DC motor. It can be controlled by varying the voltage or current it receives or by controlling its speed with pulse width modulation (PWM) techniques. In projects related to robotics and automation, the 300 RPM DC motor is frequently used. It very well may be utilized to drive wheels, gears, and other mechanical parts, and it can likewise be utilized to control the development of automated arms and different members. It is additionally utilized in robots and quadcopters to control the speed and bearing of the propellers refer fig (4.4).



Fig 4.4 200 RPM DC motor

#### 4.5 Lithium Ion Cells:

Lithium-Ion batteries are noted for their performance, reliability, and affordability. Six 3.7v lithium-ion cells is connected in series and parallel to acquire the 12V. The battery pack is 12v, 5200mah and 3c rated refer fig (4.5).



Fig 4.5 Lithium-ion cells

## 4.6 Limit Switches:

Limit switches are electromechanical gadgets utilized in different applications to recognize the presence or nonattendance of an item, limit the movement of a mechanical part, or sign the place of an item. At the point when the article comes into contact with the switch, it enacts the switch, causing an adjustment of the condition of the electrical contacts. The switch can be typically open (NO), regularly shut (NC), or have the two kinds of contacts. In a NO switch, the contacts are open when the switch isn't enacted. In a NC switch, the contacts are shut when the switch isn't actuated. Limit switches are utilized in various applications, for example, transport frameworks, machine apparatuses, advanced mechanics, entryways and doors, lifts, and other robotized or mechanical frameworks.



Fig 4.6 Limit Switch

## 4.7 Raspberry Pi 4 :

The Raspberry Pi 4 represents a significant evolution in the world of single-board computing. Launched by the Raspberry Pi Foundation, this compact yet powerful device has garnered widespread acclaim for its versatility and affordability. At its core, the Raspberry Pi 4 boasts a quad-core ARM Cortex-A72 processor, clocked at up to 1.5GHz, paired with options for 2GB, 4GB, or even 8GB of LPDDR4 RAM, providing a substantial boost in performance compared to its predecessors. One of the most notable improvements is the addition of dual micro HDMI ports, capable of supporting 4K displays at 60Hz, offering users the flexibility to create multimedia-rich projects or utilize the Pi as a budget-friendly desktop computer. Furthermore, the inclusion of Gigabit Ethernet and USB 3.0 ports enhances connectivity options, facilitating faster data transfer rates and networking capabilities. The Raspberry Pi 4 retains its hallmark GPIO (General Purpose Input/Output) pins, enabling users to interface with a wide array of sensors, actuators, and other electronic components, making it an ideal platform for prototyping and learning electronics and programming. Additionally, its support for popular programming languages like Python and Scratch, coupled with a vibrant online community, makes it accessible to users of all skill levels, from beginners to seasoned enthusiasts and professionals.



Fig 4.7 Raspberry Pi

## 4.8 Water Pump Motor

An electronic device known as a 12V water pump uses a low voltage DC power supply to move or circulate water. It is frequently utilized in hydroponic systems, aquariums, and other small water features where a low flow rate is required. Most of the time, the 12V water pump has a motor that pumps the water out to control the movement of the submarine. A 12V DC power supply, typically found in the form of a USB port or a battery pack, powers the pump. The model and design of a 12V water pump can affect its flow rate. Depending on the pump, the flow rate can range from a few liters per hour to several hundred liters per hour. Moreover, it is not difficult to introduce and work, and can be controlled utilizing a basic on/off switch refer fig (4.9)



Fig 4.9 Water pump



# **CHAPTER: 5**

## **SOFTWARE USED**

### **5.1 SOLID WORKS**

SolidWorks is a 3D CAD (computer-aided design) software used in product design, architecture, engineering, and other fields. Dassault Systèmes was the company that developed it, and it debuted in 1995. For designing 3D models of parts and assemblies, SolidWorks provides a user-friendly interface that enables users to create intricate geometries and carry out in-depth simulations.

The parametric modeling capabilities of SolidWorks make it possible for users to create parts and assemblies with defined dimensions and relationships between components. This empowers simple adjustment of plans as changes can be made to the elements of one part, and the whole model will refresh in like manner .

SolidWorks likewise incorporates a scope of devices for performing reproductions and investigation of plans, like pressure examination, movement reenactment, and liquid elements recreation. Before making physical prototypes, engineers can test their designs virtually and improve their performance, saving time and money.

One more significant element of SolidWorks is its capacity to produce 2D designing drawings from 3D models. Dimensions, tolerances, and other annotations can be added to these drawings to meet industry standards.

Using tools like version control and document management, SolidWorks also gives teams a place to work together on designs at the same time. Other software tools, such as CAM (computer-aided manufacturing) and PLM (product lifecycle management) systems, can also be integrated with it.

### **5.2 PYTHON IDE:**

Python IDEs (Integrated Development Environments) are software applications that provide comprehensive facilities to computer programmers for software development. Python 3, as a language, is supported by various IDEs. Here are some popular Python IDEs:

**5.2.1. PyCharm:** Developed by JetBrains, PyCharm is a powerful IDE for Python programming. It offers features like code completion, debugging, syntax highlighting, and integration with version control systems. It's a simple IDE suitable for beginners and provides basic features like code editing, syntax highlighting, and debugging.

**5.2.2. Visual Studio Code (VS Code):** Although not specifically for Python, VS Code is a highly customizable IDE with support for Python through extensions. It provides features like debugging, syntax highlighting, code snippets, and Git integration.

**5.2.3. Spyder:** Spyder is an open-source IDE designed specifically for scientific computing in Python. It comes with features tailored for data analysis, plotting, and debugging scientific code.

**5.2.4. Jupyter Notebook:** Jupyter Notebook is an open-source web application that allows you to create and share documents containing live code, equations, visualizations, and narrative text. It's widely used in data science and education for interactive Python programming.

**5.2.5. IDLE:** IDLE is Python's integrated development environment, which comes bundled with the Python installation. It's a simple IDE suitable for beginners and provides basic features like code editing, syntax highlighting, and debugging.

These are just a few examples, and there are many other Python IDEs available, each with its own set of features and capabilities. The choice of IDE often depends on personal preference, project requirements, and workflow preferences.

## **5.3 OBS STUDIO:**

OBS Studio, short for Open Broadcaster Software Studio, is a free and open-source software for video recording and live streaming. It offers a comprehensive set of features suitable for both beginners and advanced users. With OBS Studio, users can capture and mix multiple sources such as webcams, desktop screens, and media files, allowing for versatile content creation. It supports various streaming platforms like Twitch, YouTube, and Facebook Live, making it a popular choice among gamers, content creators, and professionals alike. OBS Studio provides advanced options for customizing stream settings, scene transitions, and audio mixing, empowering users to create professional-quality broadcasts. Its intuitive interface and extensive community support make it one of the most

widely used tools for live streaming and recording on multiple platforms

## CHAPTER 6

### CHASSIS OF THE SUBMARINE

#### 6.1 Chassis Design:



Fig 6.1 Main chassis of submarine

The main chassis of the submarine produced using PVC parades a strong yet lightweight development, expected to investigate the profundities with viability and strength. Precision planned using advanced PVC materials, this body offers exceptional softness and disintegration resistance, basic for deferred lowered missions. Its streamlined arrangement limits drag, taking into account speedy and swift improvement through water.

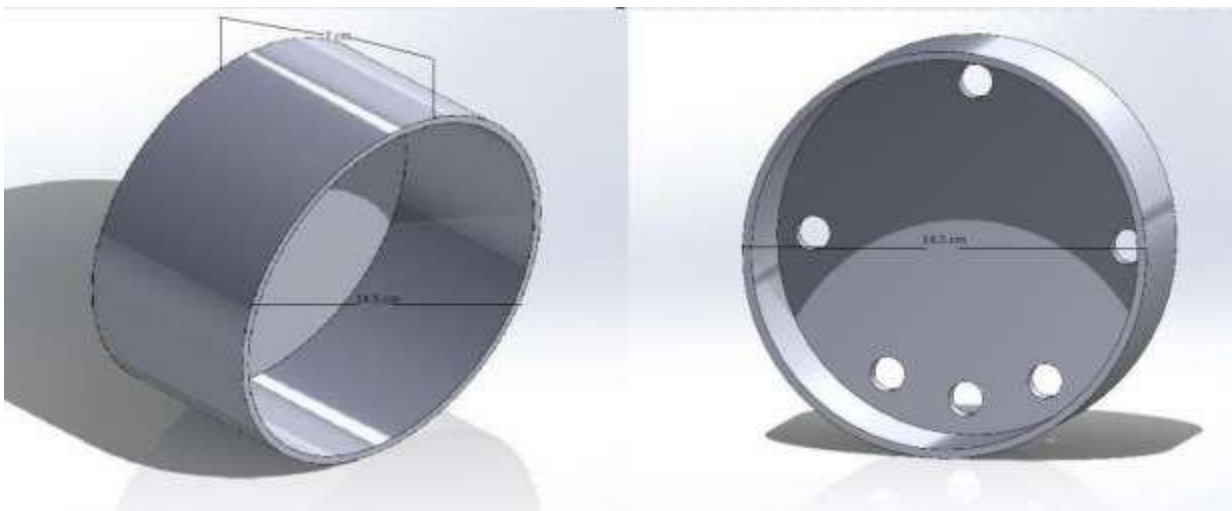


Fig 6.2 End caps of submarine

Capably formed to address subtleties, they perfectly coordinate with the body of the submarine, outlining a watertight seal that gets through the pressures of the water profundities. Their solid improvement not simply shields the inner elements of the submarine from external parts yet moreover overhauls its delicacy and security lowered. Arranged considering versatility, these PVC end covers are impenetrable to utilization and crumbling, persisting through the unforgiving marine environment with ardent strength. Their smooth profile limits drag, smoothing out the submarine's show while supporting energy adequacy. Also, the smooth fulfillment of the end covers not simply redesigns the elegant charm of the submarine yet what's more works with simple help, taking into account trouble free cleaning and upkeep.

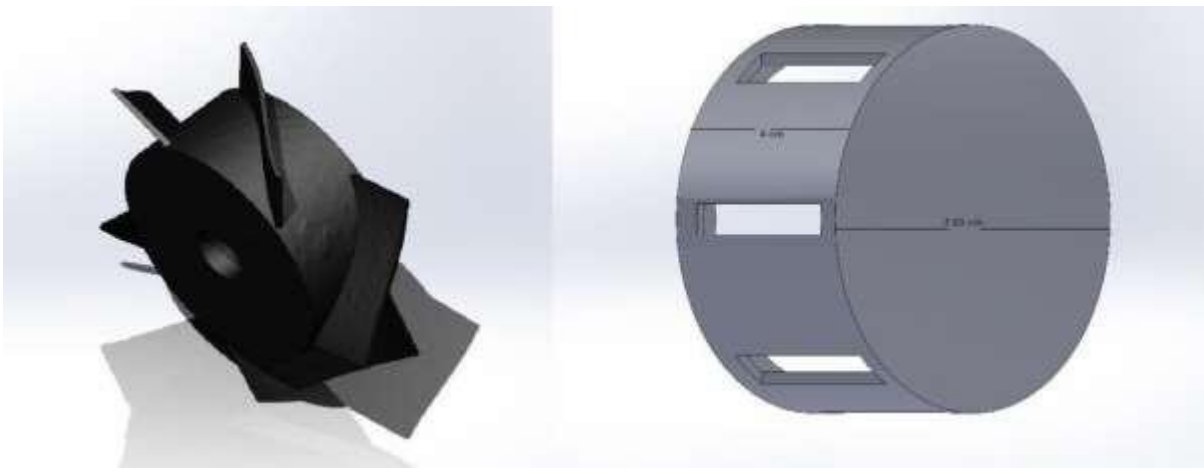


Fig 6.3 Propeller and end cap of submarine

Propellers are fundamental parts in submarines, driving them forward submerged. Created from lightweight, strong materials like plastic or metal amalgams, propellers comprise of painstakingly planned edges improved for submerged execution. Their size and pitch are customized to the submarine's particular size and power prerequisites. Propellers can be fueled by electric engines or water impetus frameworks, contingent upon the submarine's plan. Customary support, including cleaning and assessment for harm, guarantees ideal execution and life span. Legitimate establishment and arrangement limit vibration during activity. High-level plans might consolidate movable pitch or variable speed highlights for upgraded execution in changing circumstances. At last, propellers are basic to the drive arrangement of submarines, working with controlled development and route underneath the waves.



Fig 6.4 Propeller and back chassis of submarine

The back PVC chassis advancement ensures daintiness and trustworthiness even in testing lowered conditions. The material's versatility enables the underside to get through moving strains experienced at different profundities, giving reliability and essential decency. Definitively situated fortresses and facilitated fittings work on the overall strength of the body, promising it can persevere through the difficulties of lowered examination and undertakings.

## 6.2 Assembled view of the submarine:

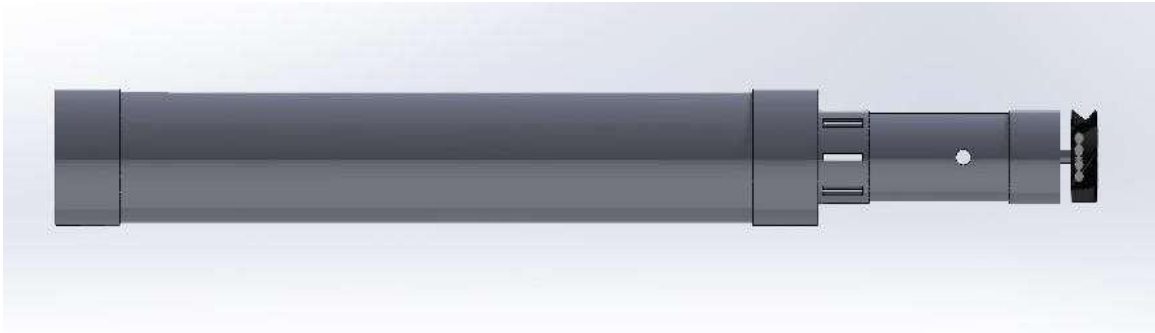


Fig 6.5 Front view of assembled submarine



Fig 6.6 Side and black view of assembled submarine

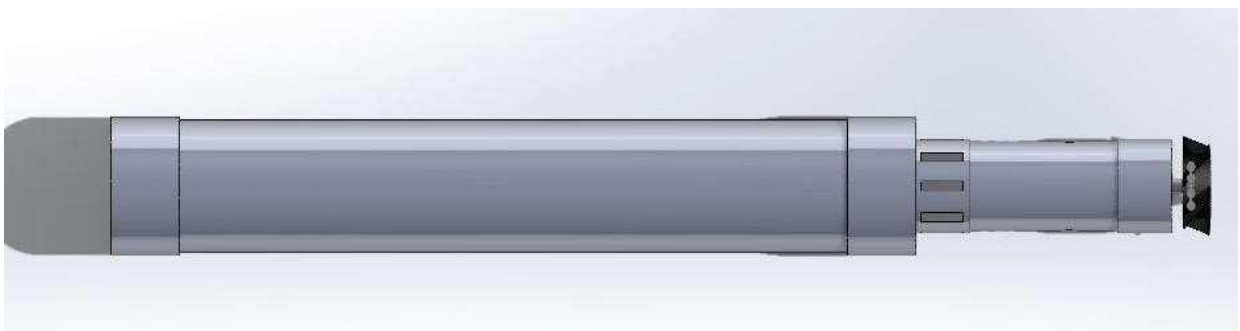


Fig 6.7 Top view of the assembled submarine

### 6.3 Fabricated images of the submarine :

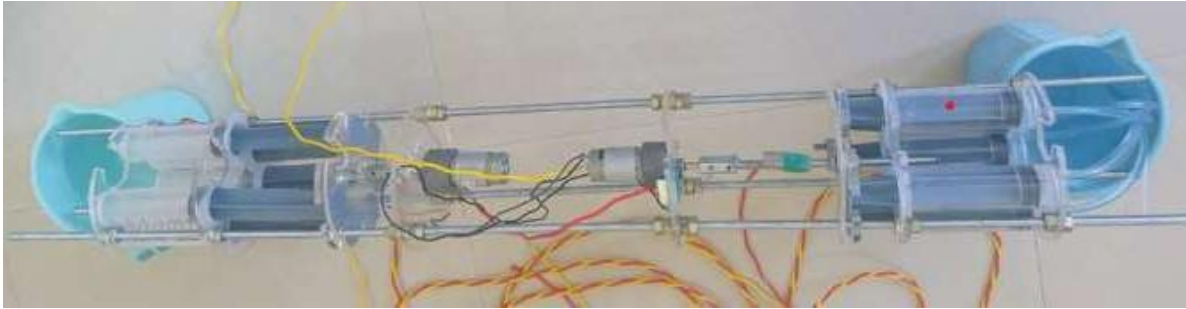


Fig 6.8 Ballast system

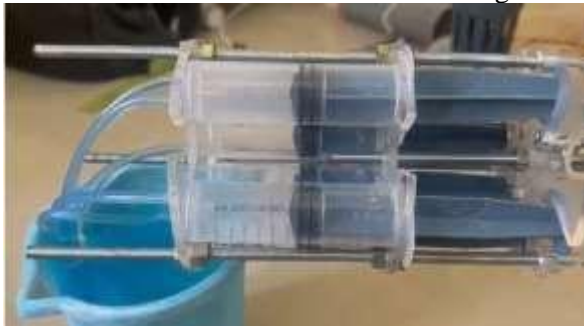


Fig 6.9 Ballast system extension position



Fig 6.10 Ballast system retraction system

The Fig 6.8 shows the ballast system incorporated in the submarine , Counterbalance frameworks in submarines duplicate the lightness control systems found in their genuine partners however in a worked on structure reasonable for sporting use. These frameworks are vital to dealing with the submarine's climb, plunge, and soundness in water. Using a weight tank or chamber, the submarine changes its lightness by modifying the volume of air or water inside it. Clients have some control over this cycle either physically or consequently. Manual control normally includes changing valves or switches, while programmed frameworks might utilize sensors or clocks. Essential systems, for example, water siphons or needles are many times used to fill and discharge the counterweight tank, in this manner changing the submarine's lightness and making it either sink or rise. Moreover, steadiness instruments, for example, movable loads or balances, assist with keeping up with the submarine's level position submerged. Wellbeing highlights like strain alleviation valves guarantee the framework works inside safe boundaries. Fueled by batteries, these frameworks work with the essential command over lightness, improving the submarine's usefulness and pleasure for clients, everything being equal. And Fig 6.9 shows the outer casing made of PVC which stands between the submarine components and water. Crafted from PVC, our submarine's outer casing exemplifies durability and versatility. This robust shell not only fortifies the vessel's structure but also



shields it from underwater rigors. Engineered to withstand oceanic pressures, it ensures our submarine's integrity in the most demanding environments. Its sleek design minimizes drag, optimizing hydrodynamics for efficient underwater navigation. Moreover, the PVC's smooth surface streamlines maintenance, guaranteeing optimal performance voyage after voyage. Complementing this casing is an external propeller, meticulously designed for top-tier underwater propulsion. Integrated seamlessly, it enhances maneuverability and speed, propelling our vessel with precision and power. This dynamic duo epitomizes functionality and innovation, enabling our submarine to explore the ocean depths confidently. From vibrant coral reefs to mysterious abyssal plains, our PVC-clad submarine, propelled by advanced technology, stands ready for unparalleled underwater adventures.



Fig 6.9 Outer casing of the submarine

## **CHAPTER 7**

### **RESULT AND DISCUSSION**

In this chapter, we delve into the intricate workings of a submarine, unraveling the sophisticated system that propels it through the depths of the ocean. At the heart of this underwater marvel lie five motors intricately connected through the advanced processing power of a Raspberry Pi 4i. These motors, comprising two DC motors, two pump motors, and a 555 Gear Motor, synergistically orchestrate the precise movements of the submarine with remarkable efficiency and control.

The DC motors play a pivotal role in regulating the submarine's buoyancy, strategically positioned alongside syringes affixed to both sides of the vessel. This innovative setup allows the submarine to manipulate water ingress and egress, thus modulating its buoyancy for controlled submersion and ascent. To ensure precision in this process, limit switches are deployed to halt the DC motors once the syringes reach their maximum water displacement, preventing overexertion and optimizing operational safety.

Complementing the vertical movement facilitated by the DC motors, the pump motors are instrumental in orchestrating lateral maneuvers, granting the submarine agility and versatility in navigation. This lateral control mechanism enables the submarine to traverse through the underwater landscape with finesse, navigating obstacles and exploring intricate environments with ease.

Meanwhile, the 555 Gear Motor spearheads the submarine's forward propulsion, propelling it through the water with unwavering momentum and velocity. This meticulously engineered gear motor is calibrated to deliver optimal thrust, driving the submarine forward on its exploratory missions with precision and reliability.

Beyond propulsion, the submarine is equipped with an array of sensors designed to monitor the delicate ecosystem of coral reefs. These sensors, including the TDS Sensor, HX710B Pressure Sensor, and DS18B20 Temperature Sensor, provide invaluable insights into the water quality and environmental conditions surrounding coral reefs. By collecting quantitative data on parameters such as salinity, pressure, and temperature, the submarine contributes to ongoing research efforts aimed at understanding and preserving

these vital marine habitats.

S.NO	TDS SENSOR READINGS (PPM)	DS182BO SENSOR READINGS (°C)
1.	100.82001	25.49
2.	103.59354	20.32
3.	126.28472	24.57
4.	100.72205	26.06
5.	129.73947	25.51
6.	105.65815	27.26
7.	113.98465	27.47
8.	121.27325	21.91
9.	111.60526	20.63
10.	122.71648	28.10

Tabel 7.1 Outputs of DS182BO & TDS sensors

To facilitate data collection and analysis, a micro-SD card module is integrated into the submarine's instrumentation, seamlessly interfacing with the Raspberry Pi 4i. This robust data storage solution ensures that valuable information gathered during underwater missions is securely captured and can be readily accessed for analysis upon resurfacing.

In essence, the submarine represents a pinnacle of technological innovation, harnessing the power of advanced motors, sensors, and processing systems to unlock the mysteries of the ocean's depths. With its ability to navigate with precision, monitor environmental parameters, and collect invaluable data, the submarine stands as a testament to humanity's quest for knowledge and understanding of the marine world.

## CHAPTER 8

### CONCLUSION

In conclusion, the submarine for coral reef monitoring addresses a convincing crossing point of innovation and ecological preservation. This submarine not just does active involvement with designing yet additionally adds to the critical field of sea life science and preservation. The submarine intended for coral reef checking fills in as an important device for social occasion information in conditions that are frequently difficult to get to. The potential applications incorporate concentrating on coral wellbeing, checking marine life variety, and evaluating ecological circumstances. This data is instrumental in grasping the elements of coral reefs, distinguishing dangers, and executing powerful preservation procedures. The venture supports advancement and critical thinking as developers address moves interesting to submerged investigation, for example, waterproofing, lightness control, and effective drive. Cooperation with sea life researchers and progressives guarantees that the submarine lines up with the particular requirements of coral reef research. The adaptable idea of a submarine works with variations for explicit exploration goals, making it a flexible stage for logical request. Nonetheless, it is crucial for approach the turn of events and sending of such an instrument capably. Contemplations for moral examination rehearses, regard for marine biological systems, and adherence to nearby guidelines to direct the undertaking. Security measures, both for the submarine and the general climate, should be vital. In rundown, a Do-It- Yourself submarine for coral reef checking addresses a strong blend of mechanical development and ecological stewardship. By cultivating cooperation, empowering logical investigation, and advancing protection endeavors, this venture can possibly make a significant commitment to the conservation of one of the World's most essential biological systems. This submarine is made on a simple mechanical and electrical concept by using the principles of buoyancy. The submarine can monitor a region of area inside the water and monitor the data of the water present near the coral reef ecosystem for research purpose. The submarine is an excellent option to monitor the coral reef ecosystem as divers diving for research can't stay in water, can't go too depth for that much time and they may also cause damage to the coral reefs while diving. This submarine is the best alternative instead of going for the research with traditional divers. The SD card module, TDS Sensor, HX710B Pressure Sensor, DS18B20 Temperature Sensor, Pump Motor, 300 RPM

DC motor and 555 Gear Motor are used to construct a submarine that is both functional and dependable. It is likely that in future, we can make more advanced underwater vehicles like submarine that can perform a wider range of tasks and provide even more monitoring of coral reef through advancements in AI, ML and ROS technology.

## CHAPTER 9

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## APPENDIX

### Raspberry pi Code for sensors:

```
import time

import RPi.GPIO as GPIO

from w1thermsensor import W1ThermSensor

from hx711 import HX711


# GPIO setup

GPIO.setmode(GPIO.BCM)

GPIO.setup(5, GPIO.IN) # DS18B20 sensor GPIO pin

GPIO.setup(6, GPIO.IN) # HX711 sensor DOUT pin

# Assuming TDS sensor is connected to GPIO pin 7

GPIO.setup(7, GPIO.IN) # TDS sensor GPIO pin


# Initialize DS18B20 temperature sensor

ds18b20_sensor = W1ThermSensor()


# Initialize HX711 pressure sensor

hx = HX711(dout_pin=6, pd_sck_pin=5)

hx.set_reading_format("MSB", "MSB")

hx.set_reference_unit(1) # adjust this value to match your sensor


try:

    while True:

        # Read temperature from DS18B20 sensor

        temperature = ds18b20_sensor.get_temperature()
```



```

print("Temperature (DS18B20): {:.2f} °C".format(temperature))

# Read pressure from HX711 sensor
pressure = hx.get_weight_mean()
print("Pressure (HX711): {:.2f} units".format(pressure))

# Read TDS value from TDS sensor
tds_value = GPIO.input(7) # Example, replace with actual TDS sensor reading
print("TDS Value: {}".format(tds_value))

time.sleep(1)

except KeyboardInterrupt:
    print("Exiting...")
finally:
    # Cleanup GPIO
    GPIO.cleanup()

```

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