



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 5, May 2023

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# Design & Characteristics Study of Automated Hoverpod Powered by Solar Energy

Dr. Sujesh Kumar<sup>1</sup>, Krithi Ganesh Kottary<sup>2</sup>, Gagan Anand Shettigar<sup>3</sup>, Avani Bhat<sup>4</sup>,  
Abdul Rehman<sup>5</sup>

Senior Assistant Professor, Department of Aeronautical Engineering, MITE, Moodbidri, Karnataka, India<sup>1</sup>

UG Student, Department of Aeronautical Engineering, MITE, Moodbidri, Karnataka, India<sup>2,3,4,5</sup>

**ABSTRACT:** The necessity for alternative fuel sources has been one of the main issues for the majority of researchers around the world due to the growing issue of carbon emissions. Alternative Clean Energy is being explored and tested as one of the primary fuels for vehicles and is unquestionably one of the most significant components of the impending future. Consequently, the next major development in technology may be the solar transportation. Experts around the world have been attempting to use solar energy again to power vehicles after successfully harnessing it to generate electricity. The aim of our project is to construct a automated solar powered hoverpod. The objective is to mount solar panels on top of a hoverpod that can be introduced with an innovative sun tracker. A solar tracking system which is based on Arduino UNO is designed and the solar panels are actuated with the help of servo motors using the sun tracking sensor with respect to the intensity of the sun light. The hoverpod is then powered by the solar energy that has been captured and the motion of the hoverpod is automated with the help of Application performance monitoring (APM). Upon further research, hoverpod can also be used for filtration purposes and they have variety of applications in the field of transportation.

**KEYWORDS:** APM, Arduino UNO, Automated, Hoverpod, Servo motors, Solar panels.

## I. INTRODUCTION

An internal combustion engine is included as standard equipment to power the vehicle. The ICE generates the energy required for the movement of the vehicle using fuels like gasoline, diesel, petrol, etc. The heat produced by burning these fuels assists in moving the engine pistons, which causes movement. However, fossil fuels like gasoline, diesel, etc. produce a significant amount of extra carbon compound gases like carbon monoxide and nitrous oxide in addition to a few others. These gas leftovers and the toxins in fossil fuels are to blame for the significantly rising levels of air pollution observed throughout the world.

Approximately 75% of the total power generation in India is accomplished by thermal power plants. Fossil fuels are depleting due to extensive use. Increasing energy demands are prompting us to move forward towards harnessing solar energy, which is a cost-free, efficient, and never-ending source of energy as well as ecological and sustainable to the environment.

A solar vehicle only relies on its photovoltaic cells to capture solar energy and transform it into useful engine power. Photovoltaic cells bypass the original principal of solar thermal energy by converting solar energy directly to usable electricity instead of thermal conversion. As a result, we can simply store converted electricity in batteries and use it to power the engine of the vehicle. Hence the idea of developing a hoverpod driven using solar energy with the help of automation, contributes to the future of sustainable energy consumption.

A hoverpod also known as air cushioned vehicle (ACV) is an amphibious craft capable of traveling over land, water, mud, ice and other surfaces. This vehicle is different from other terrestrial and conventional ones as it moves freely on various kind of surfaces and eliminates any contact with surface. It is supported on self-generated cushion of air.

### 1.1 PROBLEM STATEMENT:

- Over the centuries there have been many efforts to reduce the element of friction between moving parts. A hoverpod is a relatively a new means of transportation.
- Hoverpod have many commercial and industrial uses due to the fact that they can reach to the places where other water-craft and vehicles cannot have access.

- Solar energy is a renewable form of energy that contributes to the future of sustainable energy generation. Hence solar powered hoverpod is more sustainable than the conventional hoverpods which use IC engines for its operation.
- To monitor and sense all the direction of the sun it requires novel technique to measure and sense the important parameters.
- Using automation, here an effort is made to developing a prototype of a solar powered hoverpod that can be more efficient in trapping all the sun's energy as the solar panels can be deflected in the direction of the sun with the help of mechanical servos.

## 1.2 OBJECTIVES:

- The primary objective of the project is to develop a mode of transportation that is sustainable and environmentally friendly which uses solar energy to power the vehicle and minimize the impact of transportation on environment.
- The research aim is to make the hoverpod more effective and use less energy by employing an automated system to manage its movements.
- In locations where conventional transportation mode might not be practical, such as urban and rural areas, the project seeks to offer an alternate form of transportation over different range of environment.
- Individuals can gain knowledge about the project's potential for solar-powered mobility and the advantages of renewable energy through it.

## II. RELATED WORK

A literature review was conducted and findings related to our project was obtained. Mohit Kushwaha et.al. [1] in their paper explained about the development of a hovercraft and involved diverse thrust and lift calculations, forces, as well as the principles of hovercraft operation. The hovercraft's hover height was also estimated. Suneetha Racharalaa et.al. [4] in their study examined various types of tracking systems and discussed their advantages and disadvantages in depth. The findings given in this review confirm that the azimuth and altitude dual axis tracking system outperforms alternative tracking systems. However, in terms of cost and versatility, a single axis tracking system is more viable than a dual axis tracking system. The power and autonomous system of UAV was explained in the paper written by Agus Budiyo et.al. [6]. The UAV is made up of two major components: the airframe and the avionics system. The power system and the autonomous system are two major subsystems of the avionics system that will be examined. To power the autonomous system, three Li-Poly batteries are used in this system. An Ardupilot Mega v2.4.2 board (autonomous board), a GPS (Global Positioning System) sensor, attitude sensors, an ESC (Electronic Speed Controller), servos, a brushless motor, a camera, a data transmitter, an Audio/Video transmitter, and a Radio RC receiver comprise the autonomous system. Bhaskar Reddy et.al. [9] in their paper compared the efficiency of solar cells with and without a tracking system. They also provided a proposed design for a simple dual-axis tracking device based on servo motors and interfaced with an Arduino microcontroller kit. The servo motor receives instructions from extremely efficient light dependent resistors, which are responsible for the moment of PV panels towards maximum light intensity.

## III. METHODOLOGY

1. Literature survey is conducted.
2. The dimensions of hoverpod and solar panels required is analysed.
3. The 3D model of the hoverpod is designed using Solid works.
4. The materials for developing a prototype is decided.
5. Sensors based on the requirement and the main components of the hoverpod is decided.
6. The prototype of the hoverpod is designed by considering all the aerodynamic parameters.
7. A automated hoverpod powered using solar energy is developed and the results are analysed.

### 3.1 3-D MODEL DESIGN AND ITS SPECIFICATION:

The 3D Model of the hoverpod is designed using Solid works software by scaling down the dimensions from the original hoverpod.

The scaled down dimensions are given as follows:

- **Length of the Hoverpod:**
  - With the Pre-Inflated Cushion – 762 mm

- Without the Pre-Inflated Cushion – 662 mm
- **Width of the Hoverpod:**
  - With the Pre-Inflated Cushion – 458 mm
  - Without the Pre-Inflated Cushion – 375 mm
- **Height of the Hoverpod:**
  - With the Pre-Inflated Cushion – 275 mm
  - Without the Pre-Inflated Cushion – 214 mm

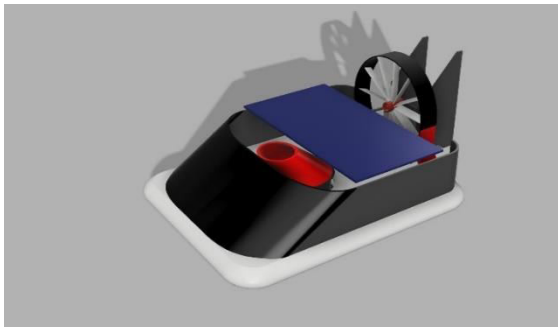


Figure 3.1.1. Side view of the hoverpod design

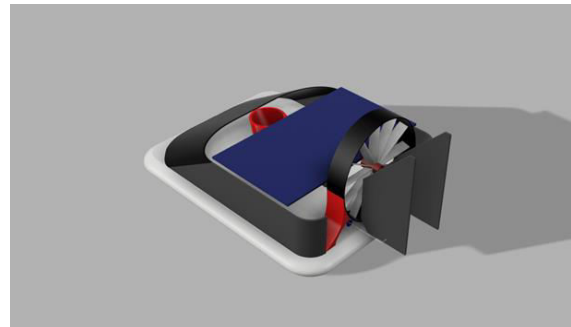


Figure 3.1.2. Back view of the hoverpod design

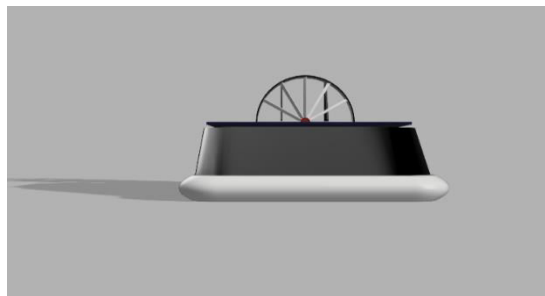


Figure 3.1.3. Front view of the hoverpod design

### 3.2 LIST OF COMPONENTS AND WEIGHT ESTIMATION:

Sl no	Name of Components	Quantity	Weight
1	Depron Sheets	5	240gms
2	High Grade Plastic Sheets	1	10gms
3	Battery (1300mAh) 4 cell	1	160gms
4	Emax Motor (935kv)	1	53gms
5	Emax BL Heli ESC (20A)	1	38gms
6	A2212 Motor (1400kv)	1	45gms
7	ESC (30A)	1	32gms
8	Orange HD Propeller	2	18gms
9	Solar Panels	2	400gms



10	Arduino UNO	1	25gms
11	LDR Sensor	1	15gms
12	Solar Battery Charger and Wires	1	160gms
<b>TOTAL ESTIMATED WEIGHT</b>			<b>2000gms</b>

Table 1. Total Estimation of Weight of the components

### 3.3 FLOWCHART FOR SOLAR PANELS DEFLECTION USING ARDUINO UNO:

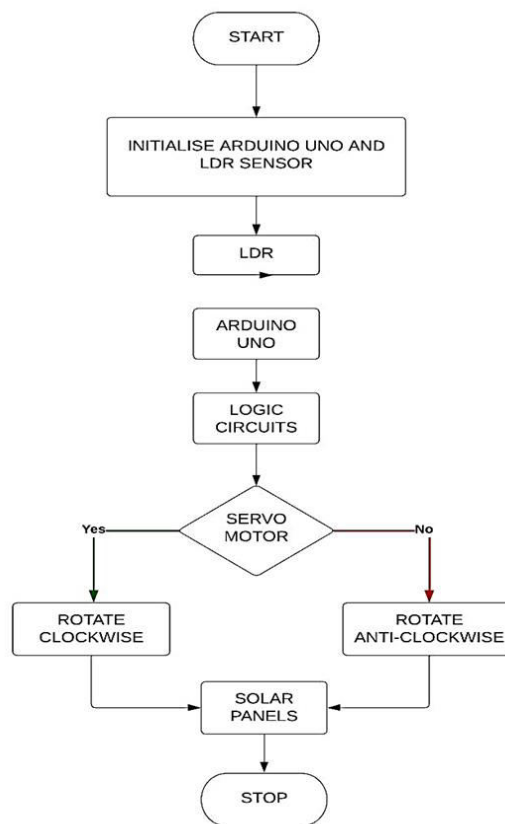


Figure 3.3.1. Block diagram of Solar Panel deflection using Arduino Uno

The LDR sensor, Arduino UNO board, logic circuit, and servo motor are all represented in the block diagram as the system's primary components. The Arduino UNO board stores the digitally encoded analogue data that the LDR sensor converted after detecting the light intensity. The servo motor's position is determined by the logic circuit's comparison of the light intensity data with a pre-set threshold value. Depending on where the sun is, a servo motor is utilised to control the direction of the solar panel. The solar panel is finally oriented to face the sun and generate its maximum power output. The code for each step will need to be written in both Python and Arduino to implement this process.

### 3.4 PROCESS OF AUTOMATION OF THE HOVERPOD USING APM AND GPS SENSORS:

The process of automation of the hoverpod is given in following steps:

1. Initialize the APM and GPS sensors.
2. Read the current speed and direction of the hoverpod from the APM system.
3. Read the current GPS location of the hoverpod from the GPS sensor.
4. Determine the desired speed and direction of the hoverpod based on the destination GPS coordinates and any other navigation instructions.

5. Compare the desired speed and direction to the current speed and direction to determine if any adjustments are needed.
6. If adjustments are needed, calculate the necessary changes in speed and direction.
7. Send signals to the motor and other systems to adjust the motion of the hoverpod accordingly.
8. Read the updated speed and direction of the hoverpod from the APM system
9. Read the updated GPS location of the hoverpod from the GPS sensor
10. If the hoverpod has not reached its destination, go to step 5

The above procedures outline a fundamental control loop that continuously reads the hoverpod's speed, direction, and GPS location from the APM system and GPS sensor, compares them to the desired values, and then sends signals to the motor and other systems to modify the hoverpod's movements as required. The hoverpod stays in the loop until it arrives at its final destination.

### 3.5 NUMERICAL ANALYSIS:

Structural analysis was performed on the model using the ANSYS-FLUENT software and the aerodynamic loads acting on the base of the hoverpod was determined. For the analysis, following material and its specifications was taken into account.

Material used	Polystyrene
Density of the material	1044 kg m <sup>-3</sup>
Young's Modulus of the material	3.4 GPa
Poisson's Ratio	0.34
Force applied	20 N

Table 2. Considerations for analysis

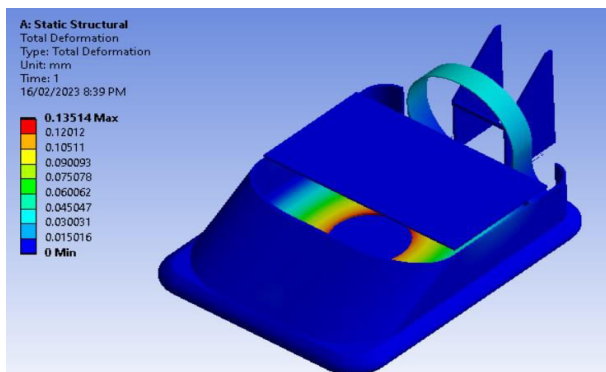


Figure 3.5.1. Total Deformation

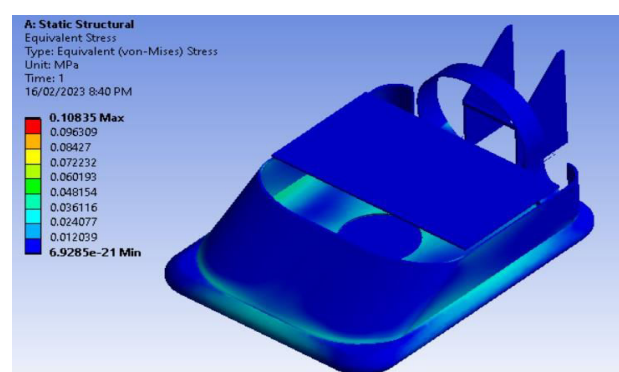


Figure 3.5.2. Equivalent Stress

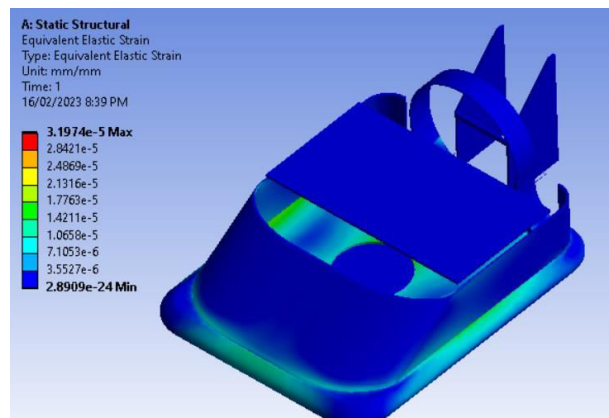


Figure 3.5.3. Equivalent Elastic Strain



**3.6 FORMULAS AND CALCULATIONS:**

Some of the basic formulas and calculations are given below:

**1. Power output of the panels:**

- To calculate the power output of the 2 solar panels with a current rating of 0.56A and 18V, we can use the formula:  
Power (P) = Current (I) x Voltage (V)

Since each panel has a current rating of 0.56 A and a voltage of 18 V, we can calculate the power output of one panel as:  
 $P = 0.56 \text{ A} \times 18 \text{ V} = 10.08 \text{ W}$

- To calculate the power output of 2 panels, we can multiply the power output of one panel by the number of panels:  
 $P_{\text{total}} = 2 \times 10.08 \text{ W} = 20.16 \text{ W}$

Therefore, the power output of 2 solar panels with a current rating of 0.56 A and 18 V is 20.16 W.

**2. Charging time of the battery:**

To calculate the charging time of a battery using a solar panel, we need to know the power output of the solar panel, the capacity of the battery, and the efficiency of the charging circuit. Assuming a charging circuit with 80% efficiency, we can calculate the charging time as follows:

- Power output of solar panel = 20.16 W
- Capacity of battery = 1300 mAh = 1.3 Ah
- Efficiency of charging circuit = 80%
- Charging current of the solar panels = Power output / Voltage =  $20.16 \text{ W} / 18 \text{ V} = 1.12 \text{ A}$
- Effective charging current = Charging current x Efficiency =  $1.12 \text{ A} \times 0.8 = 0.9 \text{ A}$
- Charging time = Capacity of battery / Effective charging current
- Charging time =  $1.3 \text{ Ah} / 0.9 \text{ A} = 40 \text{ minutes}$

**3. Hoverpod run time:**

Assuming maximum power consumption of the hoverpod to be 40W,

- Hoverpod run time = Battery capacity / Power consumption
- Run time =  $1300\text{mAh} / (40\text{W} / 1000) = 33 \text{ minutes}$

Propeller length	10 inches
Weight Of the hoverpod	2 Kg
Power output of 2 solar panels	20.16 W
Efficiency of charging circuit	80 %
Power consumption of hoverpod	40 W
Battery charging time	40 minutes
Hoverpod Run time	33 minutes

Table 3. Results of the calculations

**3.7 FABRICATION OF THE HOVERPOD:**

The hoverpod is fabricated with the suitable components. The solar panels were integrated on top of the hoverpod with the light detecting sensors and the fabrication of hoverpod is completed.



(a)



(b)

Figure 3.7.1. a) & b) Hoverpod integrated with solar panels

#### IV. EXPERIMENTAL RESULTS

The structural analysis was performed on the hoverpod and the total deformation of its base was determined which is well within the design limit that design is safe. Later the prototype was tested on both land and water and the experimental values of power output, charging time and run time of the hoverpod was noted. From the testing, it is observed that it takes around 52 minutes for a battery to charge with the help of solar energy and 21 minutes is the run time of the hoverpod. Hence in this project we will be using two batteries of capacity 1300 mAh to run the hoverpod. The power consumption capacity from one battery shifts to the other when its capacity reaches below 20%. This can be controlled using the charging circuit and battery indication sensor.

The images of hoverpod testing is shown below:



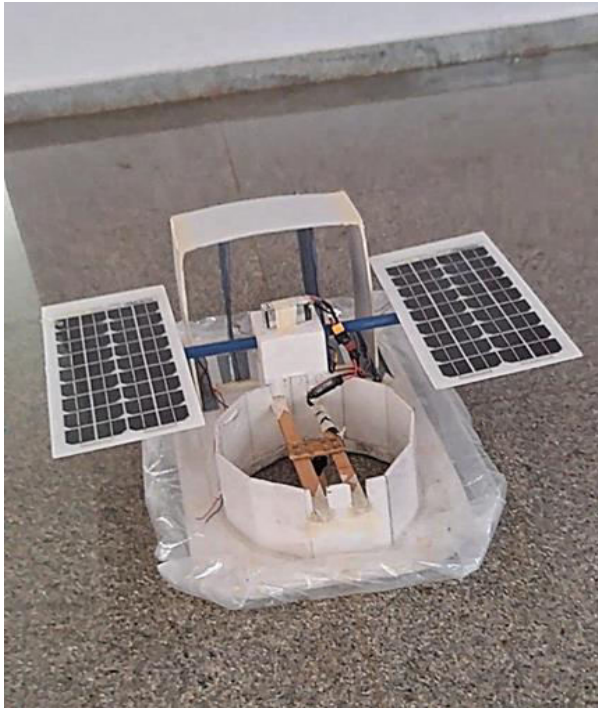


Figure 4.1. Hoverpod Testing on land



Figure 4.2. Hoverpod Testing on land

The following table represents the results obtained after the testing:

Battery Power Output	1448 W
Power used for inflation	78.48 W
Power used for producing Thrust	39.24 W
Charging time of the battery	52 minutes
Run time of the hoverpod	21 minutes

Table 4. Results noted after the testing

#### V. CONCLUSION

The development of a solar-powered hoverpod with an automated system represents a significant advancement in the field of renewable energy and autonomous vehicles. Here an attempt has been made to harness the unconventional energy resources by adopting new technology. The technology has the potential to be utilized in many other fields, such as transportation, search and rescue, and environmental monitoring. The results of this project are encouraging and show that, using solar energy to power hoverpod is feasible, but more study is required to improve the system's efficiency and optimise the design. Utilizing & harnessing the renewable energy sources can assist the transportation industry have a lower carbon footprint and help protect the environment in long term.

#### REFERENCES

- [1] Prof. Atul Dhale, Avinash Ahuja, Prashant Chanchal, Ratnesh Gupta, Mohit Kushwaha (2016) "Design and Development of Hovercraft". IJSRSET | Volume 2 | Issue 2 | ISSN : 2395-1990
- [2] Dmitry Gura, Victor Rukhlinskiy, Valeriy Sharov, and Anatoliy Bogoyavlenskiy (2021) "Automated system of dispatching the movement of unmanned aerial vehicle with the distributed survey of flight tasks" Journal of Intelligent Systems 2021; 30: 728–738.
- [3] Aly Mousaad Aly (2016) "On the Evaluation of Wind loads on Solar panels" Solar Energy 135 (2016) 423–434.
- [4] Suneetha Racharalaa and K. Rajanb.(2017) "Solar tracking system" International Journal of Sustainable Engineering ISSN: 1939-7038.

- [5] Ajinkya lonkar, Kalyani Gangurde, Pruthviraj Jadeja, Shardul Vaity, Sreejith Sreenivasan (2019) “Solar operated air cushion vehicle: a prototype”, International Journal of Scientific & Engineering Research Volume 10, Issue 5, May-2019 ISSN 2229-5518.
- [6] Ghozali S. Hadi , Rivaldy Varianto , Bambang Riyanto T , Agus Budiyo (2014) “Autonomous UAV System Development for Payload Dropping Mission”, The Journal of Instrumentation, Automation and Systems.
- [7] M. Z. A. Rashid , M. S. M. Aras , M. A. Kassim , Z. Ibrahim and A. Jamali, (2012) “Dynamic Mathematical Modeling and Simulation Study of Small Scale Autonomous Hovercraft” International Journal of Advanced Science and Technology Vol. 46, September, 2012
- [8] S.V. Uma Maheswara Rao , V.S. Surya Prakash,(2014) “Development of a Integrated Air Cushioned Vehicle (Hovercraft)” | IJMER | ISSN: 2249–6645 | Vol. 4 | Iss. 5| May. 2014 | 21 |.
- [9] Deekshith K , Dhruva Aravind , Nagaraju H , Bhaskar Reddy (2015), “Solar tracking system”, International Journal of Scientific & Engineering Research, Volume 6, Issue 9, September-2015 ISSN 2229-5518
- [10] William Retnaraj, Somnath Sengupta, Somnath Sengupta, Truong Quang Dinh, Jun Jie Chong,(2022) “Modeling and feedback linearization of an electric hovercraft for path tracking”
- [11] Tushar Khandelwal, Pawan Baheti, Ravi Raghuvanshi, Amit Jaiswal, Harsh Maheshwari, Harshvardhan Chouhan, Nakul Bansod and Ram Bansal (2021) “Design of an electric hovercraft” Advances and Applications in Mathematical Sciences Volume 20, Issue 10, August 2021, Pages 2071-2076.
- [12] Daniel F. Carlsona, Søren Rysgaard (2018) “Adapting open-source drone autopilots for real-time iceberg observations” MethodsX 5 (2018) 1059–1072
- [13] He Bin and Amahah Justice, (2009) “The Design of an Unmanned Aerial Vehicle based on the Ardupilot”, Indian Journal of Science and Technology Vol.2 No 4 (Mar. 2009) ISSN: 0974- 6846.
- [14] Mingyu Fu, Shuang Gao , Chenglong Wang, and Mingyang ,(2018) “Human-centered automatic tracking system for underactuated hovercraft based on adaptive chattering-free full-order terminal sliding mode control”, Special Section On Human-Centered Smart Systems And Technologies Volume 6,2018.



**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
**Impact Factor: 8.423**



**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

**9940 572 462** **6381 907 438** **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details