Remotely Operated Vehicle For Underwater Surveillances

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Abstract- *Marine research have become prime concern nowadays. Just like space research, marine research are needed to understand aquatic life forms and ensure their survival. This can be achieved by monitoring them using specially designed robotic vehicles equipped with specific equipments. This project is focused to design and construct Remotely-Operated Vehicle (ROV) to do such underwater operations. ROV's are remote control underwater robots driven by an individual on the surface. These robots are tethered by a series of wires that send signal between the operator and the ROV.ROVs is equipped with a videos camera, propulsion system, and lights. Special equipments like a robotic arm, water sampler, sensors to measure temperature, light penetration, and depth are can also be included if necessary .The design involves development of the PVC frame fitted with a 4-axis positioning system (Left and Right), a 2-axis (Up and down) control system to assist imaging and position stability. Arduino microcontroller-based electronic circuit is developed for the system interface that controls the motors for position of the vehicle. Simulation part was done as Phase-I which involved designing circuit and simulating it using build in models in simulation software called Proteus. the functioning of ROV requires coding to perform operation. The coding is done in Arduino compiler, which generates hexadecimal code in .hex extension. This system is designed specifically for underwater surveillance to monitor aquatic life forms ,avoid illegal poaching, and documenting purposes. The surveillance is done by using waterproof camera fitted to the vehicle.*

Keywords- underwater vehicle, marine research, thrusters, embedded systems.

I. INTRODUCTION

The 75% of earth's surface is covered with water in the form of rivers, canals, seas, and oceans. Plenty of precious resources lie underwater which are required to be explored. The key to successful explorations has always been technology dependent. Recent advances in technologies have led the possibilities to do the underwater explorations using sensors at all levels which were not possible previously

Many different underwater applications can be automated with the use of robots. Environmental monitoring and damage assessment, security applications, oil and gas installation monitoring and repair, and pipeline inspection are among the most well known. In general humans are limited to short visits underwater and only to limited depths. As such, the underwater environment holds many opportunities for deployment of robotic agents. At the same time, limited visibility, constraints in communications, as well as the application of external forces to the robot from water currents make underwater operations very challenging.

New technologies allow archaeologists to explore the human past in the depths of the ocean, far beyond the 50 meter depth boundary set by SCUBA diving. Using robots and advanced sensors originally developed for other applications, social scientists now are following the path of marine scientists, adapting deep submergence technologies for their own research. Considering the hydrodynamic features, spherical shape is very suitable for flexible motion. The spherical shape can reduce the water resistance when the robot does some rotation motions.

II. BLOCK DIAGRAM

The block consists of control unit which is Arduino microcontroller which controls the incoming and outgoing signals. Inputs are given through analog thumb stick and switches. There are 6 motors connected in the outer frame named as M1,M2,M3,M4,M5 and M6 respectively. The motors are connected to driver unit which cause motor to rotate in both directions upon respective input signals from thumb stick and push buttons. M1 and M2 Motors are used for upward and downward movement, for which input is given through Analog stick. Motors M3-M6 are used for left, right, forward and reverse directions. Two different views (Left and Right view) of the ROV are shown in the figures 2 and 3. Camera is connected to pc by Ethernet or USB cable for visual images. Flash light is used for night vision.

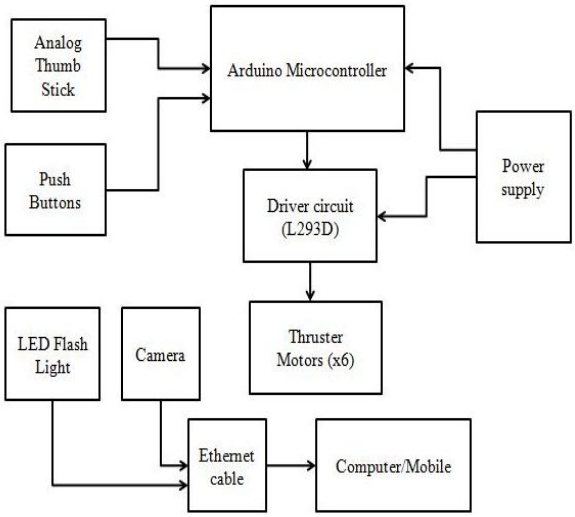

Figure 1: Block Diagram of ROV

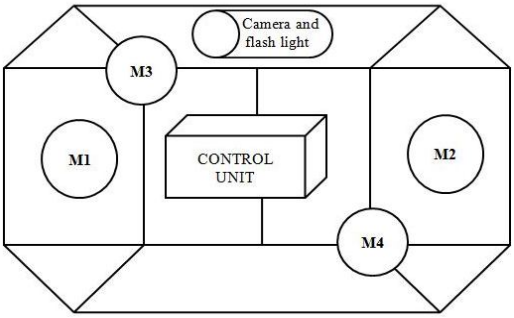

Figure 2: Two Dimensional View-Right

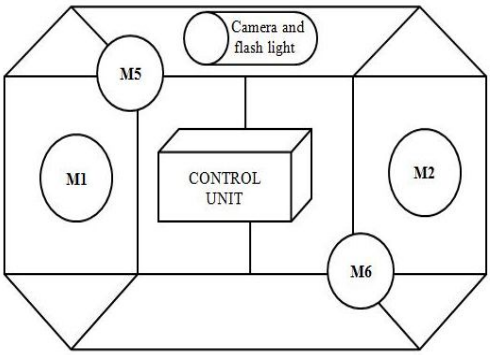

Figure 3: Two Dimensional View-Right

III. CIRCUIT DIAGRAM

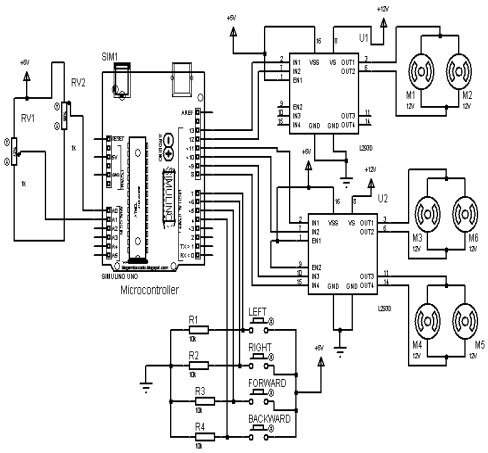

Figure 1: Circuit Diagram of ROV

The inputs are given from Analog stick and switches. The circuit diagram in figure 1, and the analog stick are imagined as potentiometer in the diagram. Analog stick is connected to A0 and A1 pin of the microcontroller. Four Push buttons are connected to 4,5,6,7 pins for backward, forward, right, left. Two drive IC whose enable pin are connected to +5V supply and the ground pins are connected to ground potential. Inputs to first driver IC are given from pin 13 and 12.Input for second IC are given from 11,10,9 and 8 pins. If analog stick is moved downwards, the input is given to analog pins and then the respective signal is given to LM293D IC which cause the motor rotates in anticlockwise. This causes vehicle to move, down. In similar way if analog stick is pressed upwards the motor rotates in clockwise and vehicle moves upwards. Upon pressing pushbuttons respective signal are given to driver IC which causes motor to spin in direction for left, right, forward and reverse directions.. The camera is directly connected to laptop and the output images can be seen on the LCD monitor. The flash light can be used in case of dark surroundings.

IV. OPERATION OF THE SYSTEM

The are six different modes of operation. Depending upon the input given from thumb stick and push buttons, the motor rotate in clockwise or anti-clockwise direction. The arrangement of motors are place in such a way that it induces certain movement upon input signal. The modes include

a. Upward mode
b. Downward mode
c. Forward mode
d. Reverse mode
e. Left mode
f. Right mode

a. UPWARD MODE

In upward mode, motor M1 and M2 rotate in anti-clockwise direction. This motion causes the vehicle to pull the vehicle outside to the surface of the water. The operation which is shown schematically in the figure 1 and 2 which shows the movement of motor from two side perspective.

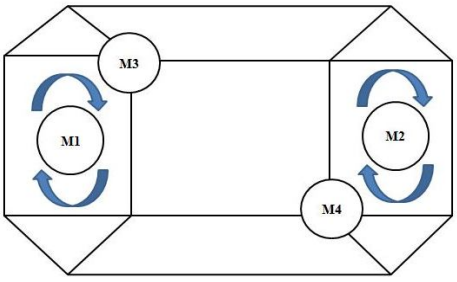

Figure 1: Upward direction Side 1

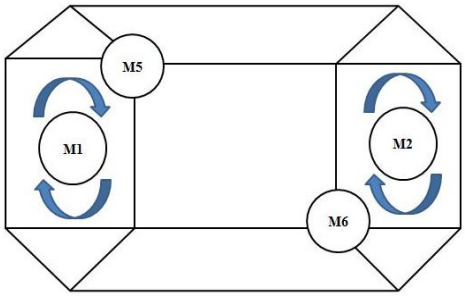

Figure 2: Upward direction Side 2

b. DOWNWARD MODE

In downward mode, motor M1 and M2 rotate in clockwise direction. This motion causes to push the vehicle inside to the water. The operation which is shown schematically in the figure 3 and 4 which shows the movement of motor from two side perspective.

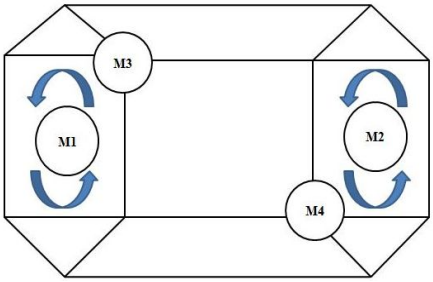

Figure 3: Downward direction Side 1

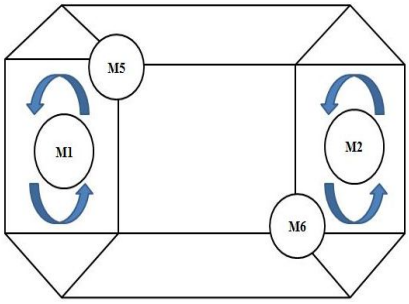

Figure 4: Downward direction Side 2

c. FORWARD MODE

In forward mode, motor M3,M4,M5 and M6 rotate in clockwise direction. This motion causes push the vehicle to move forwards inside the water. The operation which is shown schematically in the figure 5 and 6 which shows the movement of motor from two side perspective.

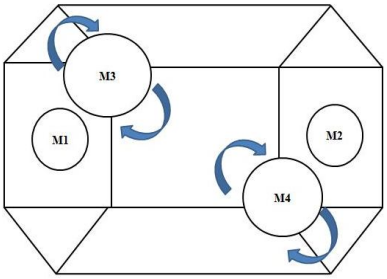

Figure 5: Forward direction Side 1

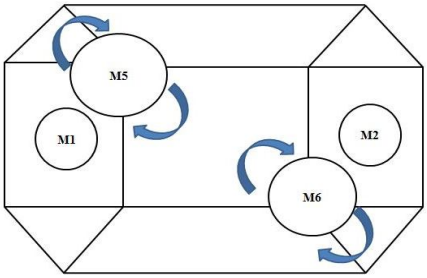

Figure 6: Forward direction Side 2

d. REVERSE MODE

In reverse mode, motor M3,M4,M5 and M6 rotate in anti-clockwise direction. This motion causes pull the vehicle to move backwards inside the water. The operation which is shown schematically in the fig 3.11 and 3.12 which shows the movement of motor from two side perspective.

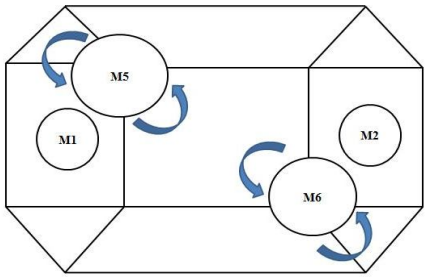

Figure 5: Reverse direction Side 1

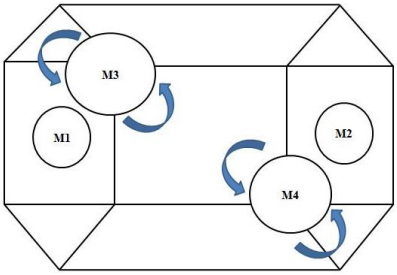

Figure 6: Reverse direction Side 2

e. LEFT MODE

In left mode, motor M3 and M6 rotate in anti-clockwise direction and motor M4 and M5 rotate in clockwise direction This motion causes the vehicle to align left side inside the water. The operation which is shown schematically in the figure 7 and 8 which shows the movement of motor from two side perspective.

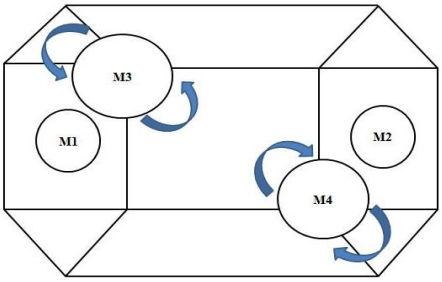

Figure 7: Left direction Side 1

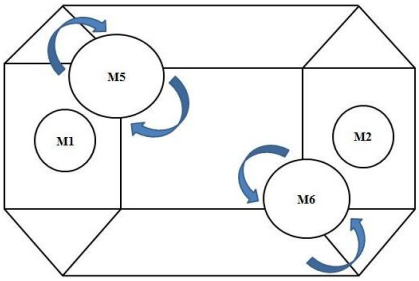

Figure 8: Left direction Side 2

f. RIGHT MODE

In right mode, motor M3 and M6 rotate in clockwise direction and motor M4 and M5 rotate in anti-clockwise direction This motion causes the vehicle to align right side inside the water. The operation which is shown schematically in the fig 9 and 10 which shows the movement of motor from two side perspective.

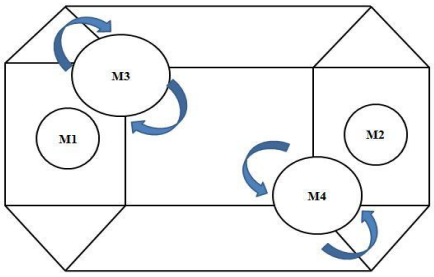

Figure 9: Right direction Side 1

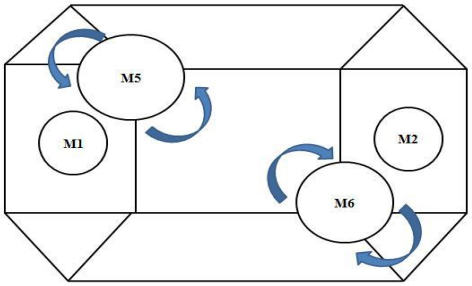

Figure 10: Right direction Side 2

V. CONCLUSION

This project started with the overall goal of combining interests and newly developed skills, to produce a potentially useful and interesting device. Fully working underwater vehicle is designed and constructed from the scratch, utilizing and learning many new skills and overcoming many challenges along the way. Throughout the entire project, many possible improvements and additions were envisioned, and suggested by others. Following completion of the project, many of following ideas will be examined for implementation. This include addition of special components like robotic arm, sensor for depth and temperature measurements, and tilt rotate for camera.

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