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AMPHIBIAN ROBO: AN INTELLIGENT RESCUE ROBOTIC VEHICLE

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ABSTRACT

Using the basic concept of a hovercraft we planned of making a surveillance robotic vehicle for military which can be used in cases of extreme crisis like a natural calamity where there is a huge loss of life and property. In such areas there is an immediate need of rescue operations and supplies. But the rescue operations have no specific direction as they have no idea of the extent of damage and the kinds of barriers. This puts their life and as well as the affected people's life at stake. In such situation we need a vehicle which can be controlled remotely and also which can help the military do their channelize their resources and help them execute the rescue missions successfully and efficiently both on land and water by providing crucial information and data to control station (PC) which may further be used to plan and strategize further rescue operations. The basic prototype is designed to be ZIGBEE controlled and consists of different types of sensors like ultrasonic sensors which is used to check the distance of any object from it and accordingly drive the robotic vehicle in the suitable direction, GPS module which is used to track the vehicle and receive the coordinates of desired place, and send relevant data to the PC through 'ZIGBEE' modules, which is one of the most powerful and cheap mode of long distance transmission of data. The robotic vehicle sends the live video feed to the PC using the roborealm software. The wireless camera which is installed on it can monitor the affected area remotely and send us vital information. This Robo can be used in star hotels, shopping malls etc where there can be threat from intruders or terrorists. Since human life is always precious, these hovercrafts are the replacement of army personnel against terrorists in war areas. This hovercraft has many applications. It can save a lot of lives by its valuable information as lack of vital information acts as a major barrier in case of such emergencies. It can carry small payload even (for e.g. Syringes, medicines etc.). A hovercraft of this type can be useful when other communication system will not operate during time of disasters which was recently observed during the cyclone Hudhud and Kashmir flood. During these critical periods, administrators, NDRF or army can use them to monitor the situation.

Keywords: hovercraft, GPS, ZIGBEE modules, amphibian ranger.

INTRODUCTION

There are lots of disasters like cyclone, flood, landslides etc. that occur all of a sudden and Floods & landslides are dangerous among them. As we know Floods& landslides produce a devastating effect and they see no difference between human and material. Hence a lot of times humans are buried among the soil and it became impossible to detect them. A timely rescue can only save the people who are buried and wounded. Detection by rescue workers becomes time consuming and due to the vast area that gets affected it becomes more difficult. So the project proposes an autonomous robotic vehicle that moves in the natural calamity prone area and helps in identifying the alive people and rescue operations**.** A unique Passive Infrared sensor is used in the project which emits infrared rays to detect humans. As live human body emits thermal radiation it is received and manipulated by the PIR sensor to detect humans [1].Once the people are located it immediately gives audio alert visual alerts to the authorities so that help can reach the live person so fast. It also sends the location of the coordinates to the PC through the GPS implemented in the robotic vehicle. This PIR sensor is placed on a moving all direction robot that can maneuver in the calamity prone areas. The LM35 Temperature sensor is used to sense unusual changes in the temperature. These are automatic led array that gets lighted up when the intensity of light comes below a threshold voltage which is continuously monitored by LDR fitted with the robotic vehicle.

FEATURES OF AMPHIBIAN ROBO

The main peculiarity of the vehicle is Tireless**.** It has great speed compared to other vehicles. These vehicles can attain higher speeds than land vehicles and use much less power than mini helicopters of the same weight .This type of vehicle can equally ride over ice, water, marsh, or relatively level land**.** It would make water pretty much a non-obstacle [2].

The importance of amphibian ranger in field of rescue operations include:-

- Reconnaissance and mapping: It is an especially important task in wide area rescue situations created by natural disasters. In these situations, assessment of situation is needed to launch search and rescue missions successfully. In this task unmanned aerial vehicles could be very useful [3].

- Search is another essential task: Victims has to be found first in order to rescue them. In order to use robots for search in wide area S&R situations they'd have to do the work at least as efficient as humans can. Whether it is possible is a disputable question. However, there are big hopes that robots will aid search missions in urban search and rescue situations in a foreseeable future. Small unmanned ground vehicles could penetrate the rubble deeper than humans or canine rescuers can, thus enabling the rescuers to find victims at a faster rate [4].

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- Other rubble penetration situations: Robots' ability to penetrate rubble can be used for other purposes as well. This ability can be used to aid in structural inspection of the rubble by enabling more throughout and complete view. Also in-situ medical assessment could be provided using this ability [5].

- Rubble removal and aid in victim extraction: The rubble removal operations in search and rescue situations are considerably different than rubble removal in construction or demolishing tasks. Still, rescue robots and exoskeletons could be used to aid rescuers in this task [1].

- Low footprint pressure: The pressure that it exerts on its operating surface is conservatively 1/30th that of the human foot! The average human being standing on ground exerts a pressure of about 3 lb per square inch (20 KPa), and that increases to 25 lb per square inch (172 KPa) when walking. In contrast, this vehicle exerts a pressure of only 0.33 lb (2.2 KPa) per square inch - even less as speed increases. This "footprint pressure" is below that of a seagull standing on one leg. They have literally flown over a pedestrian without inflicting harm [2].

PRINCIPLE OF HOVERCRAFT

A conventional hovercraft (like ours) has three main components: some sort of platform. A motorized fan and a skirt.

The fan blows air underneath the platform, where it is trapped between the platform and the ground by the skirt. This region of trapped air underneath the hovercraft is called a plenum chamber. And the air flowing into the chamber forms a ring of circulating air around the base of the skirt that helps to keep the air underneath the platform from escaping. Since more air is being forced into the plenum chamber all the time. The air underneath the hovercraft is at a higher pressure than the air outside the chamber. This high pressure air pushes up on the hovercraft (to get a better understanding of air pressure. Squeeze a blown up balloon - the reason why the balloon pushes back when you squeeze it is because the air in the balloon is at a higher pressure than the air outside the balloon). When air pressure pushing upward on the hovercraft perfectly balances gravity pushing downward. The hovercraft "floats" on a cushion of high-pressure air [5].

Since so little of a hovercraft is actually touching the ground - only the edges of the skirt - it can't be steered like a car or an airplane [6].In practice. A hovercraft is like a puck on an air hockey table - since there is so little friction between it and the ground. It tends to go in whatever direction it is pushed in. most hovercrafts have a fan attached to the back of the vehicle that blows air backwards which pushes the vehicle forward. Rudders are put behind the fan to control the flow of the air which allows the driver to steer. We have also found that steering can be accomplished by leaning

from side to side - this causes drag on one side of die hovercraft, which makes the vehicle pivot around. In order to speed up the driver makes the fan turn faster pushing more air backwards behind the hovercraft [7].
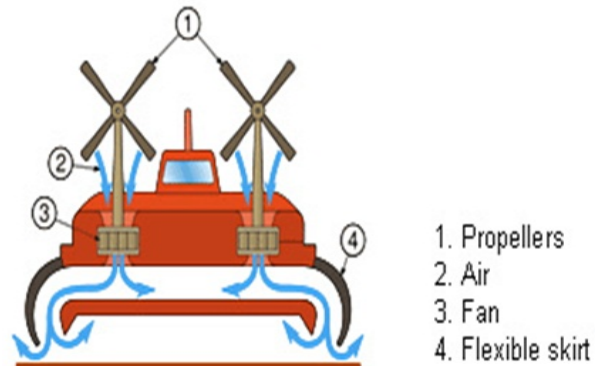

Figure-1. Parts of hovercraft.

MECHANICAL DESIGN

Concept of evolution: was based on a motion possibility on more than 1 medium (ice, water land gullies) by breaking the forces of friction. The peculiar shape has been obtained from a living organism (mice) as its pace movement through cultivations.

Materials used-

- 4xboard, flexi board
- Electronics: BLDC motors
- ESC (electronic speed controls)
- Sensor modules
- GPS MODULE
- Camera module
- Sprayer mechanism
- Ultra sound sensor
- LIPO Batteries
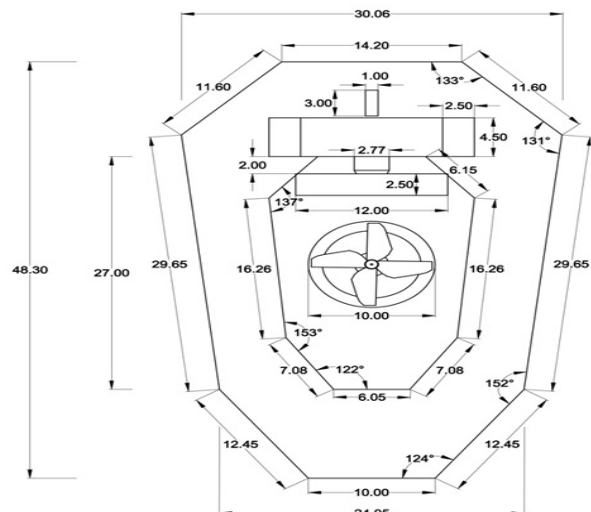- Power and wireless control system

Figure-2. Basement design.

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Construction: The main part of the system is a thruster that produces thrust to produce air cushion that help the vehicle to hover through any surface. It include an EDF- electric duct fan constructed using BLDC, electronic speed control (ESC). The pitch and angle of the propeller is design to produce maximum thrust an effective thruster is developed by high precision cutting and tilting of propellers. In case of the thrust system, it is the acceleration of a mass of air that produce produces the thrust. Newtonian physics states that every action has an equal and opposite reaction and this is exactly what causes the thrust, accelerating air out of the hovercraft causes a thrust propelling the hovercraft forward.

The basement is constructed using flexi board for better handling and to reduce the weight. The basement was created with proper dimensions to a shape of mice. The skirt of the mechanism that provide air cushion was made by a synthetic resin. Thus our first prototype was evolved based on the above mentioned procedures of construction. The prototype worked successfully and was tested in various medium
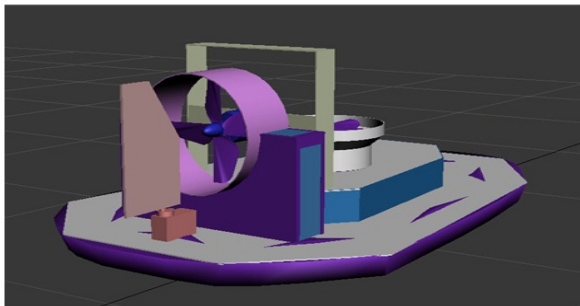

Figure-3. Cad view of final prototype.
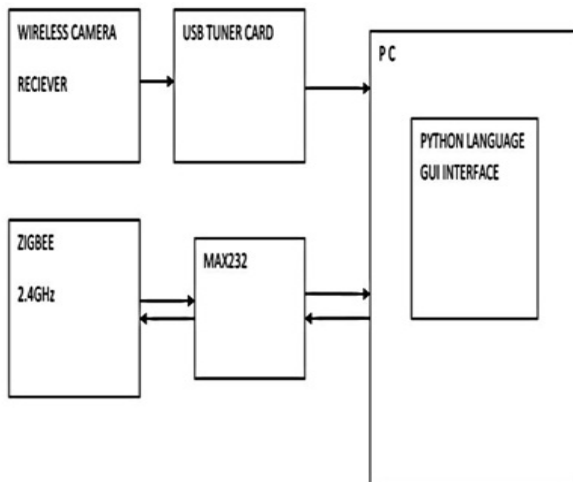
ELECTRONIC PART DESIGN
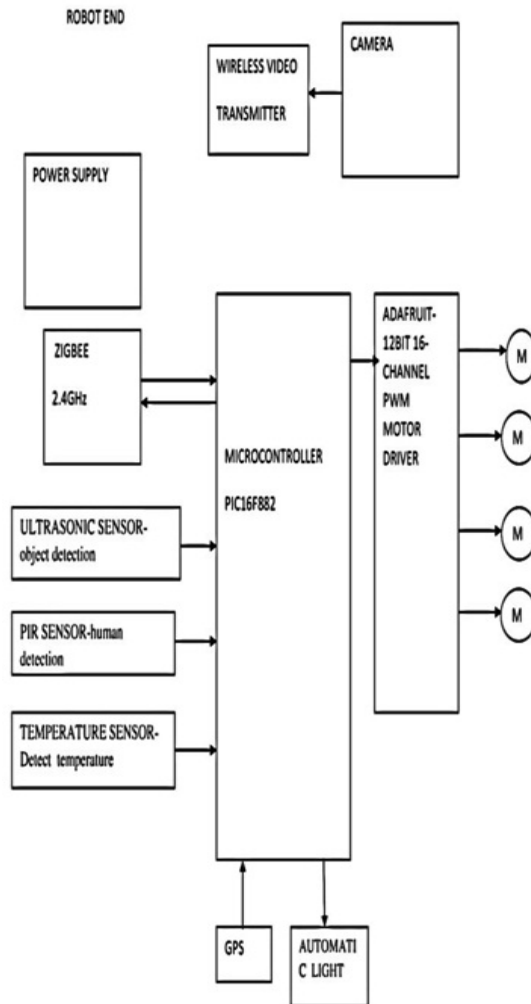

Figure-4. Transmitter section.

Figure-5. Receiver section.

Working: The wireless camera is connected the robot and the captured images are send to the pc using the frequency band of 2.4ghz and the received image is processed and viewed in the PC using the software roborealm. The Robotics movements are defined with the help of using the python software. The software transmit the data which defines the robotic movements this data is transmitted using the Zigbee and the microcontroller defines the movement to robot by driving a motor driver

The PIR sensor fitted in the robotic vehicle will always study the surrounding environment (IR pattern). Any change in the infrared (heat) level emitted by surrounding live bodies will generate a voltage measured by an on-board amplifier that trips the output to indicate motion.

The temperature sensor fitted will measure the surrounding temperature and transmits this data to the PC. Once the PIR detects a human the coordinates of that location is send to the pc with the help of GPS module fitted with the robotic module. An infrared wireless camera is fitted that helps in night vision. When the intensity of surrounding light decreases(i.e. during night

time) below a threshold voltage the led array that gets lighted up to attract the attention of the people and thus helping in intelligent rescue operation.

RESULTS AND DISCUSSIONS

The Amphibian Robo has been a resounding success as it is fully functional according to its work scope. This amphibious vehicle can travel on both land and water surface. The hovercraft is operated and maneuvered autonomous control by using programming and ultrasound distance sensors. It can detect alive humans with the help of PIR sensor and locate position through GPS. Automatic lights will get on when there is no enough light. Temperature sensor will detect the temperature of surrounding and readings are shown on laptop. Video surveillance can be done through wireless camera interface using roborealm software.
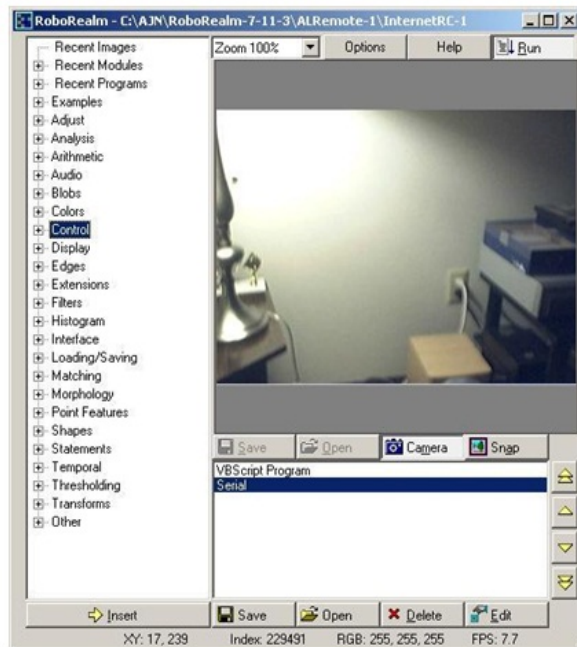

Figure-6. Video footage by roborealm.

Figure-7. Amhibian Robo testing on land.

Figure-8. Amphibian Robo testing on water.

ISSUES AND FUTURE DEVELOPMENTS

This project has not been without any challenges, which are predominant in the undertaking of such an assignment. The initial lift supply, which was a two-bladed propeller similar to the current thrust propeller, was inadequate to provide the necessary down force to direct the air into the plenum chamber and out from under the hovercraft's skirt. It was not efficient and its design was not optimal for such a task. However, this issue was resolved with the usage of a smaller yet more powerful ducted fan. The material of the skirt could be improved to a more durable yet flexible one, had it not been for the difficulty in sourcing a more favorable material. With a better-constructed skirt, the airflow and efficiency of the air cushion system could be enhanced.

Environmental Impact: Both the Lipo and NiMH batteries contain toxic chemicals that can pose an environmental threat. All batteries will be appropriately used and recycled [8].The hovercraft itself is run entirely on electrical circuits and has no emissions. When operating the hovercraft safety as well as noise was considered in choosing the time and location.

Future Developments: Although Amphibian Robo was successfully developed and met the objectives, however it is found that this hovercraft can still be improved by implementing some modifications.

PIR sensor can be replaced by a D6T sensor which is capable f or detecting stationary humans too.(more sensitivity than that of PIR).More sensors can be provided to analyse the surroundings.

We can also use its basic model in agriculture too. The soil condition of paddy fields is very soft and the sinkage is very high .Moving through this soft soil is very difficult even for a single farmer, thus pulling or pushing a device through the field is even a hectic and hard task. Ordinary remote controlled vehicles which having tires are failed to move on this type of marshy areas. So we thought of using principle of hovercraft to carry the farming mechanism over the field, so that this vehicle can hover the ground easily and remote control to control the farming mechanism means that farmer doesn't have even

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to step into the field. He can just stay at outer field and the control the vehicle and control farming operations through his remote [6].

CONCLUSIONS

Engineers are inventors. They engineer their inventions for the betterment of human life and their existence. Our project is one of the updation of hovercraft mechanism which allows it to move through agricultural field to fulfill agricultural needs. It is much flexible in this field and can also be used for other purpose like rescue or monitoring areas.

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