DESIGN AND STUDY OF AUTONOMOUS DREDGER

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Abstract-Locations with water bodies the accumulation of mud is a major problem. Usually these deposits are removed periodically with regular dredging vessels, but the time required for cleaning for extracting the mud is very much higher and manpower required is for long span of time. Traditionally it can be extracted with the use of surface floating dredgers but it consumes more fuel, requires more manpower and if the water bodies like lake or river have a greater area then it becomes one of the costliest options in the field of dredging.

Therefore, with the changing trend and use of autonomous systems in the field of automobiles it led to the development of autonomous dredger which will be smaller in comparison to large traditional dredger. The autonomous operation will ensure unattended dredging operation on 24x7 bases.

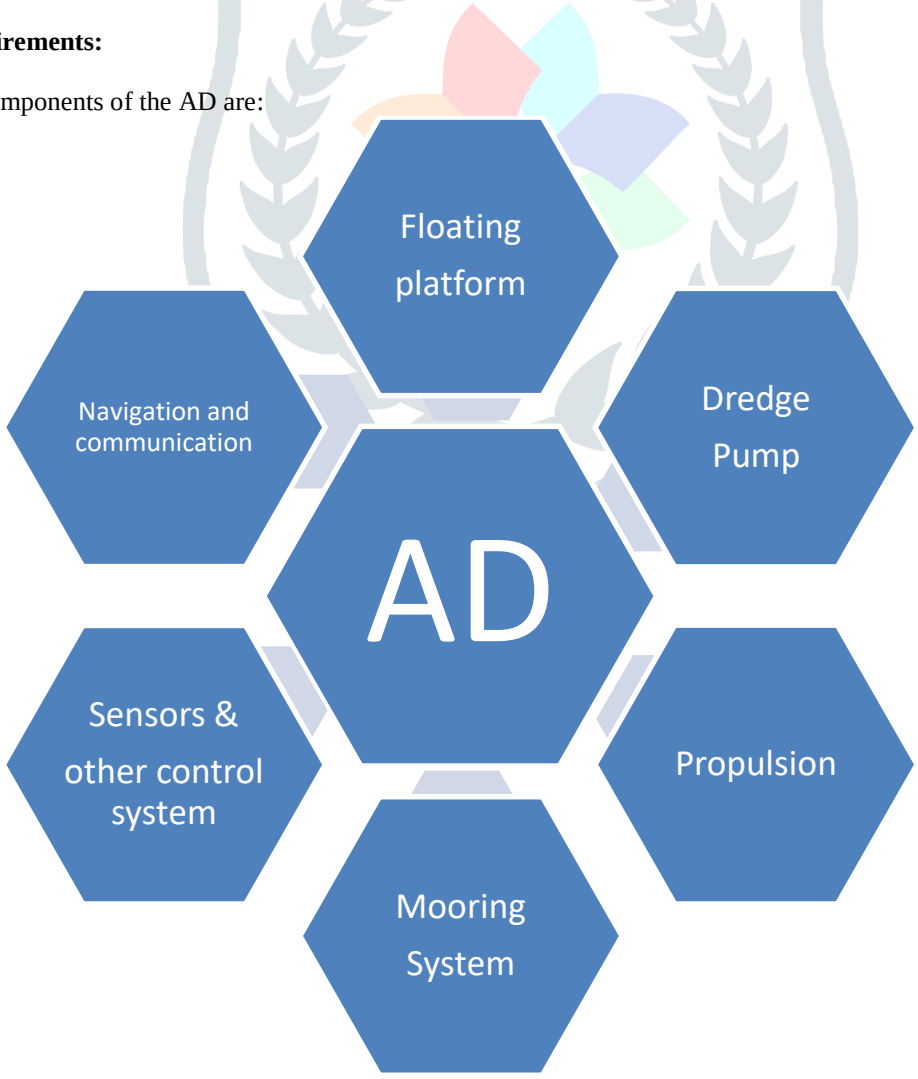
Introduction-

The Indian Maritime University, Visakhapatnam Campus has taken initiative to develop and design the autonomous dredger and make it work on one of the reservoir in Andhra Pradesh named Meghadri Gedda, a fresh water reservoir near Visakhapatnam. The original capacity of the reservoir being around 23 Mm^3. got silted up substantially over the past years. Since this reservoir is the source of water supply to the Visakhapatnam city, de-silting and restoring its capacity has become an urgent need.

After the DPR conducted in the year 2016 it was found that the required dredge volume is around 3.26 Mm^3. The available capacity for any submersible dredge pump is between 150 m^3 to 1200 m^3. Taking account with the lowest possible flow rate of pump i.e. 150 m^3 it will take around 900 days or two and half years approximately.

Design requirements:

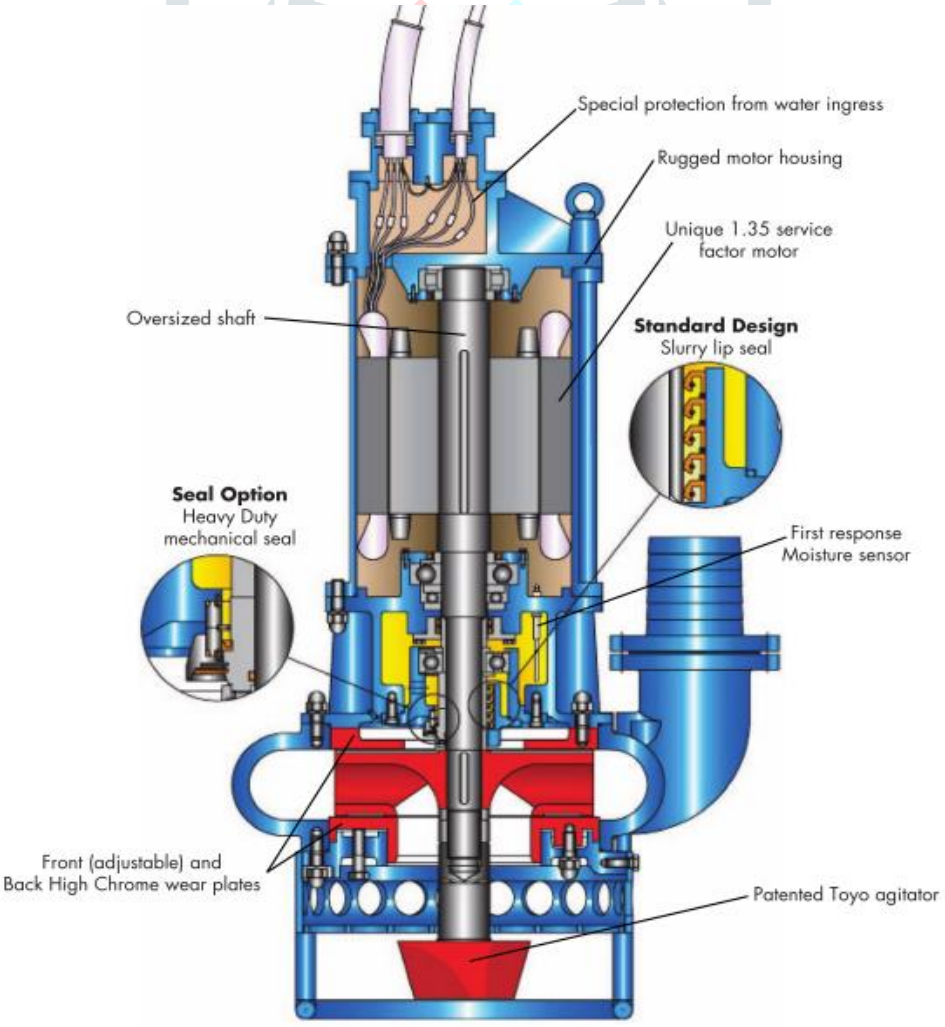
The major components of the AD are:



The floating platform will be of Catamaran Barge type. The approximate dimension proposed is 6mX3mX2.1m (dimension for each demi hull), space between each demi hull is 3m. Mobility of bargecan be possible with the help of four winches. Mooring system will be used for lowering and rising up the pump with the help of the pulley mounted on an A-frame. Navigation system GPS and other advanced system will be used. Sensors mounted on the barge will control the movement of barge as well as lowering and rising of dredge pump. The barge will also be used for survey purpose where the bathymetry of the reservoir will be calculated and according to which amount of slurry will be dredged. Dredge pump type: submersible agitator type. If the bottom is hard enough that require loosening of soil the later can be achieved by cutting by mechanical means and later erosion by suction using suction pumps.But if the bottom is soft then submersible dredge pump with agitator can be used for the suction process. These submersible pumps, operating directly in the slurry, are low noise machines. They do not require any special construction for their installation. They also offer possibility to work in narrow spaces. The built in agitator lifts there sediments and creates homogenous slurry mixture. This makes continuous pumping of slurries with high concentration of solids possible. The approximate depth considered is 10 meters. Pump will be mounted on an A-frame with the capacity of safe working load up to 2tons.

Electronic components for AD

- AVR microcontrollers,
- A module,
- Camera,
- TV tuner,
- Laptop,
- Keypad,
- Power supplies,
- Motor drivers,
- motors,
- Carbon rods
- Mechanical parts



Picture courtesy: DP Brochure, toyopumps.com

This project will have two ends: the transmitter and the receiver.In the transmitter side there will be software 'Dredge Controller' which will control the motions of motions of autonomous dredger.The software will consist of various instructions like forward, backward, left right and stop. Other instruction includes, lowering and lifting of pump.These controls can be manual controlled from the remote locations and as well as automatic.A microcontroller is basically a kind of processor and consists of program that contains instructions for the dredger.

Conclusions-

1. Autonomous dredger works effectively in the calm water and shallow water condition. This will encourage the dredging for boosting inland water way traffic and reservoir de-siltation.
2. Due to the lack of sophisticated maneuvering systems and dredging operations, this low-cost dredger will come handy and can be easily used anywhere in the country where calm water dredging is needed.
3. Small size and its capability of being assembled will increase its ease and decrease the cost of transportation.

References-

1. Development of Autonomous Dredger for Inland waterways and enclosed water bodies, Indian Maritime University, Visakhapatnam Campus, India.
2. MSc thesis by Rob Swart, Autonomous Dredging of Mud, Delft University of Technology.
3. Eco-Friendly Robotic Dredger, International Journal of Research ISSN: 2348-6848 Vol-3, Special Issue-3, International Conference on Research and Recent Trends in Engineering and Technology (ICRRTET).
(http://edupediapublications.org/journals/index.php/IJR/issue/archive)
4. DP Brochure, Toyo Pumps, www.toyopumps.com
5. Eddy Pumps corporation, www.eddypumps.com