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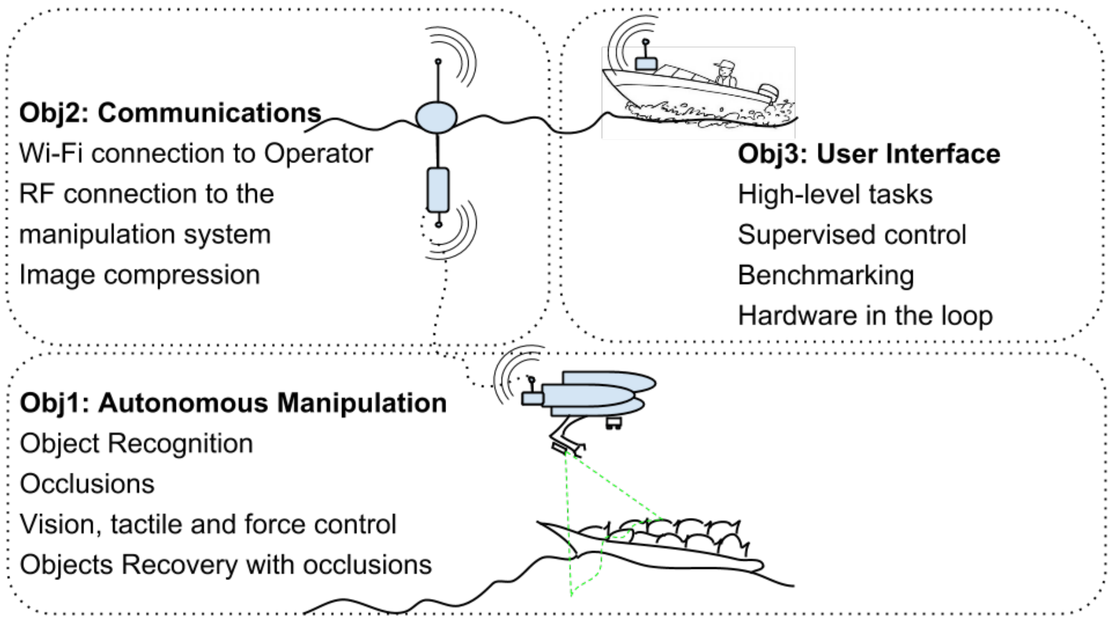

Fig. 1: Envisioned Concept and main assumed goals to be achieved.

ID33- WIRELESS RF CAMERA MONITORING FOR UNDERWATER COOPERATIVE ROBOTIC ARCHAEOLOGICAL APPLICATIONS

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Abstract - The increasing demand for underwater robotic intervention systems around the world in several application domains requires of more versatile and inexpensive systems. One example of such applications is the archaeology, where experimented divers study and reconstruct the history, recovering key objects in order to classify and preserve them properly. Moreover, this task is especially dangerous at deeps below 50 meters, where the archaeologist needs more sophisticated diving equipment and degree of experience due to high risk to which it is exposed caused by possible decompression situations. The use of supervised semi-autonomous robots can help to this task. To achieve this goal, a wireless communication system can provide freedom of movements to the robot and, at the same time, will allow the operator to get camera feedback and supervise the intervention.

Keywords - Underwater Robotics Intervention, Autonomy, Wireless Communications, Image Compression, Image Transmission.

1. INTRODUCTION

In the context of the MERBOTS research project, a three-year coordinated project funded by the Spanish government for the period 2015-2017 under grant DPI2014-57746-C3 [1], one of the roles of our research group inside the MERMANIP subproject is to build a wireless communication system that can provide freedom of movements to the underwater robot and, at the same time, to allow the operator to get feedback and supervise the intervention (see Figure 1). This wireless communication system is based on radio-frequency (RF) and will allow compressed image transmissions between the robots and the human operator. MERBOTS represents the natural continuation of several research national and international projects in the last years in the field of underwater robotic intervention (i.e. RAUVI [2], TRITON [3] and TRIDENT [4]). One of the objectives of MERMANIP is to provide different communication technologies that will be used for allowing the operation of a vehicle without any physical connection to the surface operators, which are supervising and controlling an intervention task. Our research team is in charge of the design of a wireless communication underwater system that is able to transmit telemetry data as well as compressed low-resolution images, allowing the implementation of cooperative intervention missions.

2. UNDERWATER RF COMMUNICATIONS

Previous experiments show that communications between underwater robots are possible through radio frequency signals at several meters. The objective now is to explore the new possibilities to provide a point-to-point underwater radio frequency networking system able to transmit telemetry data as well as compressed low-resolution images. A range of different frequencies (e.g. 433MHz, 868MHz, etc) has been explored to guarantee the communication service [5]. The next step will be the design of an adaptable networking protocol to enhance the cooperative underwater manipulation mission.

To allow the system to perform robotic underwater interventions, the use of video cameras input is crucial, allowing the robust storage, compression and transmission of well-synchronized video on both, through the umbilical (wired) and on the Radio Frequency channel (unwired robot). Moreover, due to the fact that the available network will present a dynamic behaviour due to the specific location of the robots at each moment, as well as the interferences, the communications protocol must be well integrated with the video compression and transmission algorithms. In fact, depending on the actual services offered by the network (i.e. latency, bandwidth), the video compression and networking parameters could be adjusted accordingly to improve the general behaviour of the whole system, always guaranteeing the efficient storage and transmission of the mission video input.

3. THE PROPOSED COMMUNICATION SYSTEM

The proposed communication system will connect the surface with the intervention vehicle (see Figure 1), allowing the access to the network through a wireless Wi-Fi channel at 5 GHz (<10Km), and connecting this device to a second one, which will establish a radio connection with the first one by using two channels, one for sending and one for receiving. Through these channels, the compressed images, the feedback from the sensors and the control commands will be sent to the vehicle. The system will include a specific communications protocol that will adjust in real time the compression ratio depending on the available bandwidth at each time, thus guaranteeing a minimum quality to allow proper monitoring of the intervention by the expert operator. It is also considered the objective of improving the compression system, allowing the quality adjustment of the scene by regions, when the user requires higher image quality in a specific area (e.g. around the manipulator arm).

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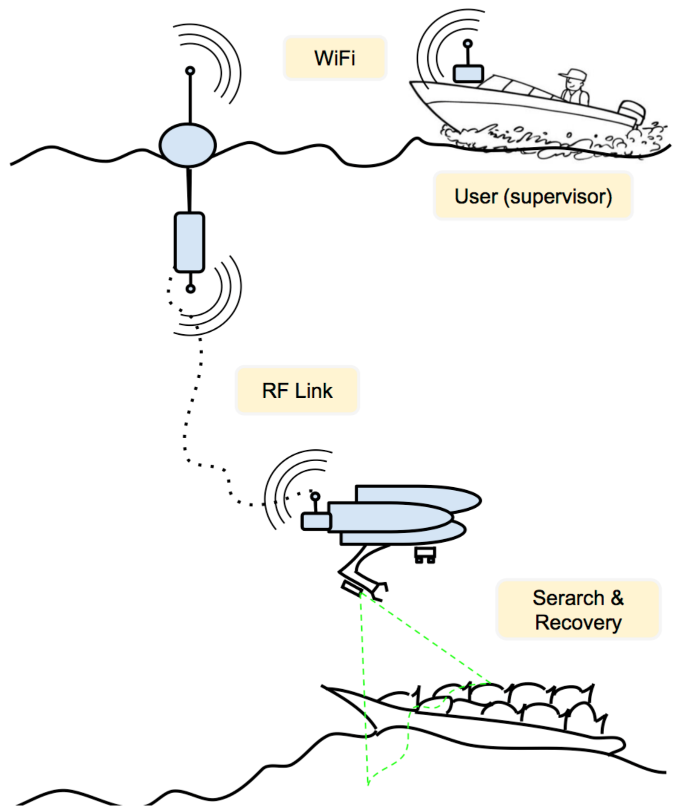

Fig. 1: Search and Recovery in the context of archaeology. A wireless RF link provides feedback to the user that is supervising the intervention