Design and Development of an X4-ROV

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***Abstract*—Remotely operated vehicle (ROV) is an unmanned underwater vehicle (UUV) used for conducting underwater task to replace a human diver in the risky job. X4-ROV is a micro observation class ROV to be used mainly for visual observation of underwater structure or environment by utilizing a high definition web camera. The designed vehicle structure was aims towards portability and maneuverability in attitude motions of roll, pitch, and yaw, and the translational motion forward/reverse/lateral. This work explains the use and modification of an open-source platform (OpenROV) into X4-ROV system.**

Keywords—underwater technology; X4-AUV; OpenROV

I. INTRODUCTION

Remotely operated vehicle (ROV) is a type of the unmanned underwater vehicle (UUV) use in underwater exploration for carrying out the hazardous task in challenging environment [1]. The demands for these vehicles become significantly high during 1980 and were made by oil and gas industry [2]. In a few years later, an extensive research and development for UUV are done for deployment in many areas of interests. Currently, unmanned underwater vehicles are used in research and deployment for many fields of operations. In the maritime sector they are used to inspect a ships' hull condition [3]. Use in the oceanographic discovery and water pollution research in the science field [4][5] and most ROV is deployed for commercial undersea operation as seen in oil and gas or telecommunication industry [6].

Another class of unmanned underwater vehicles mostly used for underwater study is autonomous underwater vehicles (AUV). The difference of AUVs and ROVs is that AUVs are controlled automatically by on-board computers and can work independently without connecting to the surface. ROVs, on the other hand, are controlled or remotely controlled by the human operator from a cable or wireless communication on the ship or on the ground [7].

An observation class unmanned underwater vehicles priority is real-time data telemetry between vehicles and operator for a successful mission, the presence of human operator makes complex multi-objective underwater missions possible: humans can react to sudden changes in a mission plan caused by the unpredictable nature of the ocean environment [8]. AUV, however, are more suitable for a pre-determined mission where data collection is the main goal and operator intervention is unnecessary [9]. Furthermore, due to the limitation of the advance technology AUV is still limited in both autonomy and capabilities. For this purpose, a ROV system is a definite choice for a given task. Commercially modern ROV systems can be categorized by size, depth capability, onboard horsepower, and whether they are all-electric or electro-hydraulic.

Generally, commercial ROV is group into four categories small, medium, heavy, and seabed class. The small class consists of micro and mini ROV with power less than 5hp use for the shallow underwater observation that carrying a camera for observation or inspection. The medium class ROV is that power up to 50 hp. They are the larger size and durable construction to handle more pressure in the water, step up in propulsion size and increased payload, and usually fitted with manipulators to give them ability in handling some objects. The heavy class ROV is the vehicle with typical power less than 220 hp, they are heavy duty vehicle use to perform more challenging tasks, and typically fitted with multiple tools and manipulators to carry out specialize tasks. Seabed class is highly specialized vehicles use to lay undersea pipes and cable on seabed power at least 200 hp.

This paper is divided into five sections. The first section explains generally on ROV system. The second section will be the X4-ROV development. The third section is about X4-ROV design and development of the prototype and at fourth section is for discussion. Finally, the conclusion section reiterates the main contributions of the work and highlights some of the possible future improvements.

II. X4-ROV DEVELOPMENT

ROV system performance is a delicate balance between design and operational characteristic trade-offs. They are formed by a highly interrelated group of the subsystem to provide impressive subsea capabilities. The design of X4-ROV is based on a few operational goals: low cost, high mobility/portability, and live data streaming (video feed).

The project is divided into two major parts which are mechanical design, and electronic/software development. The overall vehicle system is shown in Fig. 1.

A. Hull Design

X4-ROV is a type of ROV with a torpedo hull shape and is driven by four thrusters allocated on the side of the fuselage at equal intervals. Assigning the thrusters on the side of the