Polystyrene Foam-based Leg Tip Strider Robot

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Abstract— **This paper presents the water strider robot design with polystyrene foam-based leg tip approach. With reference to the biological size and flexible maneuverability of water strider this robot suitable to be applied as autonomous instrumentation unit for water quality monitoring application. The density of the main body is designed with less than 1g/cm^3, which is less than density of the water. Four motors are placed at the four side of the robot's body and driven by two half-bridge drivers via a microcontroller. The system is remotely control via computer unit through 3DR Radio module. According to the analysis on various experiments it shows that the size of polystyrene foam and the degree of copper leg play important role by supporting the robot's body and the floating of robot on the water surface.**

Keywords—quadruped configuration, polystyrene foam leg, 3DR Radio module

I. INTRODUCTION

Water strider or Gerridae is an insect that can stand, walk even jump on the water without sink. This light and small insect used high surface tension of water and its long leg with hydrophobic micro hair to repel the water and preventing drops from weighing down the body. Therefore through the observation of this creature, the strider robot have designed by several researchers with different approaches such as Water Dancer IIa [1], water walking robot [2] and STRIDER II [3] are example of robot that inspired from Gerridae biological structure and behavior. Water Dancer IIa is developed with tele-controlled using infrared signals with capable of turning and speed regulation. In addition this strider robot is designed with lighter structure material and low power consumption.

Another water strider robot with novel buoyancy based water decoupled parallel mechanism with three micro electromagnets [4]. Moreover the dynamic model of driving mechanism is built according to kinetic energy theorem for striding purposes. On the other hand, piezoelectric unimorph actuators have been designed and implemented for another water strider robot reported in [5]. This Piezoelectric driven water strider is designed with multiple actuators to create complex motion since this actuator only available for one degree of freedom (DoF). It is different to water strider robot proposed in [2] whereby spring actuation mechanism is used. This robot consists of four supporting legs and two actuating legs, a micro DC motor, two springs and a set of gears allows under-actuating mechanism applied on striding period. The STRIDER II has different focus on water strider robot balancing and striding solution. This robot used novel circular footpads for high lift, stability, payload capability and a new elliptical leg rotation mechanism for more efficient water surface propulsion stated in [3]. Furthermore, STRIDER II's circular footpad is designed in order to increase the total length subjected to lift force while keeping the total area of the supporting structures relative small. According to the existed strider robots [7-12], most of the design is emphasized on balancing and stable striding including the special material design although some of the design has creating boating system rather than striding system.

Therefore, this research has taken initiative to propose another approach of strider robot by using sponge as a leg tip. The proposed polystyrene foam-based tip strider robot is designed with economic components that consist light transparent perspex sheet as body structure material, PIC microcontroller unit (MCU), dual driver for each four micro-motors driven and radio frequency (RF) wireless module. This article will discuss the overall design of proposed polystyrene foam tip strider robot, the polystyrene foam -based tip and leg design and discussion on the measurement and analysis of leg/tips design.

II. SPONGE-BASED LEG TIP STRIDER ROBOT SYSTEM CONFIGURATION

The polystyrene foam -based tip water strider robot is designed with two layers of body structure consists of electronics control board (top) and cover (bottom) with dimensions as shown in Fig.1 and Fig.2 respectively. For the bottom body frame part, all components are placed on the center of the body frame including couple of 12V A23 batteries, two 3V coil batteries and 3DR wireless module. On the other hand, fours micro-DC motors are placed every each diagonal side of body frame.