STAIR CLIMBING ROBOT: DESIGN AND DEVELOPMENT

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ABSTRACT

Mobile robots used in indoor navigation should be capable of navigating through sudden changes in height such as stair cases or steps that typically occur inside buildings. Some of these robots are designed to lift and carry weights as well. In order to achieve autonomous navigation, the robots should be able to identify steps or stair cases, their orientation and move over or move down the steps while maintaining stability.

There has been extensive research on stair climbing robots to improve their climbing ability, mechanical complexity, ability to identify the layout of the stairs etc. Lower body weight, reduced the power consumption and increased payload carrying capacity are also main concerns when designing a robot that can climb stairs. Robots employ different types of mechanisms for their locomotion. Some of these robots used a wheeled mechanism while legged or tracked mechanisms are proposed in others.

In this work we present a stair climbing robot with a wheeled structure. The proposed design has high mobility on a flat ground as well as over an inclined surface, such that robot can move around freely in a typical indoor space. When the robot encounters an obstacle in its path, identified as a stair case or a step, the robot can transform itself to reach the upper edge of the step by lifting a section of the chassis with the aid of a side wheel driven on the vertical surface of the step. The friction of this wheel and step surface as well as the forward motion of the robot will guide it to reach and move pass the upper edge of the step and drag up the chassis one step at a time.

The chassis design consists of two main sections, the base carrying the wheeled structure for regular motion and the lifting mechanism complete with the side wheel to handle stairs. A stair climbing robot should be lightweight to climb up and down easily, at the same time the chassis and the wheel system should be strong enough to withstand forces acting on it during the lifting stages. Main circuitry, power sources and actuators contribute to the overall weight of the design besides the aluminum frame and wheels. Maintaining the center of gravity at the physical center of the prototype as much as possible during climb up and down stages was also a major concern.

The finished prototype weight is 1100g while its dimensions are 204mm in length, 140mm in width and 220mm in height. The wheels were powered with low rpm motors, as it helps the robot to keep the motion under better control allowing the climbing process to be carried out in a more accurate and precise manner.

***Key words*:** Lifting mechanism, Stair climbing robot, Indoor navigation.