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Novel discrete actuator based on multistable mechanism devoted to digital microrobotics

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Thanks to the discrete actuators, digital micro robotic appears today an emerging branch in microrobotics. It allows obtaining robust and repeatable discrete positioning in open loop, e.g., without measurement systems. Regarding the literature, the existing discrete actuators have a limited number of stable states. Most of them are based on bistable mechanism, switching between two stable states. In order to increase the number of stable positions, several bistable have been combined. However, the size of the mechanism increases rapidly, and its miniaturization becomes complex and non-intuitive. To overcome this limitation, an unlimited number of stable states is proposed. It allows switching linearly its moving part between several stable positions in one direction. Upward and downward steps are made by a specific sequence of moving, using one bistable module, opening and closing two internal clamps which are actuated using three subsystems. As a proof of concept, a prototype providing 13 stable positions with a step of 10 μ m is designed. This prototype of the discrete actuator is fabricated on SOI (Silicon on Insulator) substrate using DRIE (Deep Reactive Ion Etching) method. Then the prototype's repeatability and reproducibility are addressed. The results show that a displacement of 120.67±0.08 μ m is achieved over 12 upward steps with a mean step of 10.06 μ m, which is very close to the designed performance.

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