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| **Title:** | Design and Implementation of an IoT-based Smart Bio-Toilet with Hygiene Maintaining System | | |
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| **Abstract:** |  |
| Abstract—This research report focuses on designing and implementing an IoT-based bio-toilet system that prioritizes health, hygiene, and eco-friendliness. This work encompasses deep knowledge of IoT, microcontrollers, bio-toilet systems, engineering design issues, and health and hygiene issues. This is an interconnected sub-system or component having a wide range of applications, including a PV system, sensor systems, microcontroller, structural system, etc. In this smart toilet, a proper hygiene maintenance system has been incorporated. Focus was given to reducing the water consumption in this bio-toilet system. Besides, the method of power generation from biogas and human waste in the toilet system was exploited. Also, an effort was made to produce biofertilizers from human waste. In this work, a method of purifying water by absorbing water from waste was used. In this bio-toilet, extra electricity was provided from solar energy, thus preventing wastage of electricity. The Internet of Things (IoT)-based smart bio-toilet with a hygiene-maintaining system uses IoT cloud monitoring for centralized and remote monitoring, control, and analysis of several bio-toilets together. The simulation was done with the Proteus software, and hardware implementation was done using an Arduino microcontroller. Both simulation results and experimental results are obtained. | |

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| **Abstract:** |  |
| Abstract—This paper presents a low-cost, modular, LDR sensor-based crowd management system. The system utilizes dedicated entry and exit detection modules, each incorporating an LDR–laser setup and LM358 comparator circuits to generate digital count pulses. These pulses are processed by independent controllers driving seven-segment displays for real-time entry and exit counts. A central controller calculates net occupancy, compares it against a user-defined threshold, and triggers the entrance gate to close, currently implemented as an LED indicator when the limit is exceeded. The system was simulated in Proteus with varying crowd flow rates to evaluate accuracy. The results show that the system can count up to three people per second. The entrance gate responds within 445 µs, corresponding to the total measured propagation delay from input trigger to gate activation while consuming only 1.8 W of power. These findings demonstrate the system’s reliability, fast performance, and adaptability for integration with automated gates. Unlike existing high-cost solutions, this design uses simple, low-power components and a dual-controller architecture to maintain accurate counts with minimal processing overhead. The proposed solution is particularly suited for event venues, transport hubs, and other controlled-access environments where real-time crowd regulation is essential. | |