INTELLIGENT STORAGE SYSTEM MV2ME: ELECTROMECHANICAL CONSTURCTION ANALYSIS
REVIEW PAPER

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Abstract: *Originality of this proposal of low maintenance intelligent storage system is based on novelty motion methods used very little in real-life application apart from maglev trains. Current storage systems consist of mechanically actuated conveyor belts and automatic mounted forklifts. The proposed construction solutions could lead to revolution in lowered requirements for replacement of parts and lubrication.*

Keywords: *intelligent storage, regular grids, linear motors, magnetic levitation,*

1 Introduction

Low maintenance systems are consistent with long term sustainability goals of industry. In this solution we want to remove the need for operational space on top of the individual shelves and whole cabinet wall. Such solution increase capacity, however require to use more sophisticated methods for container actuation. Also whole system must support cataloguing of containers' content and enable searching. This requires cooperation of experts from different fields such as physics, mathematics, engineering and computer science.

Current storage systems use much extra space for container moving assembly like moving forklifts, conveyor belts. Also the catalogue systems are inflexible and require much manual input.

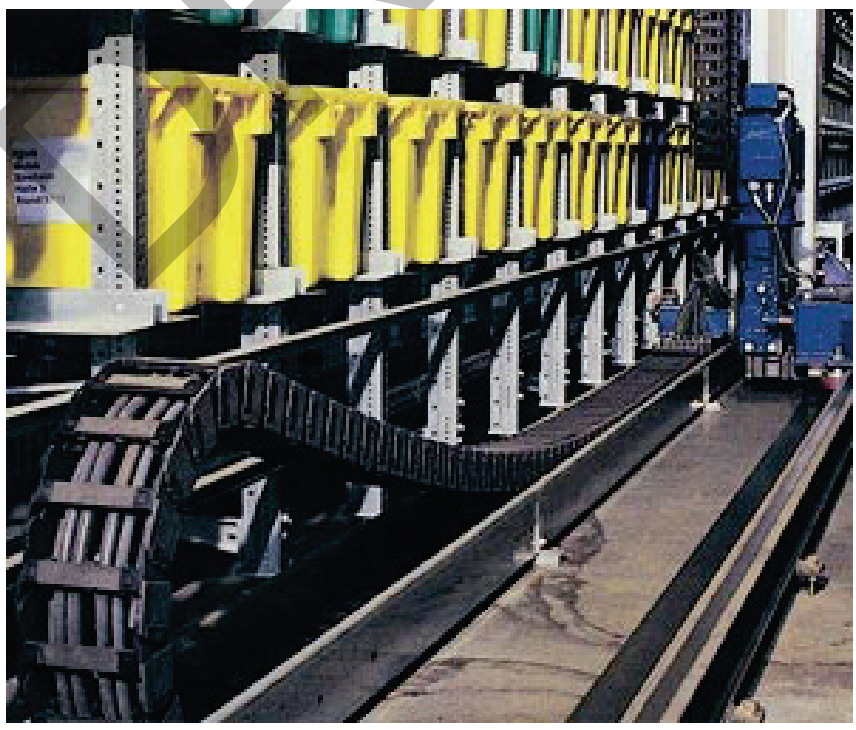

Fig. 1: Classical container storage system [ref:wiki]

Fig. 2: Conveyor belt based solution [ref:wiki]

Fig. 3: Multi-agent storage solution [ref:wiki]

2 Problem Formulation

Controlled magnetic levitation or other low friction methods of actuation require sensor and emitter grids. Clever usage of permanent magnets could also greatly reduce the energy requirements for transporting containers. One of the open questions is if the containers that have to remain stationary would be locked in place actively or just by suitable shape of its bottom and the shelf itself.

3 Proposed Solution

We propose to explore solutions based on regular shaped containers in regular grids. By simulation we have tested some properties of rectangular grids and we propose also hexagonal grids. The means of actuation could be magnetic levitation, linear motors or combination.

The containers are on shelves in cabinet with basic operation of moving a container to a free space. So at least one free space on the shelf must be preserved.

In this case the elevator can be stationary, moving only in vertical direction. Access across whole rows is not required.

For assisted cataloguing in the elevator area should be camera and every time a container is deposited on the shelf, a picture is taken and stored in database.

Controlled magnetic levitation is a field where is much to be explored. Many experiments show feasibility of the solution, however large grid applications are still not well understood. Such grids seem to be scalable from home storage to large shipping facilities.

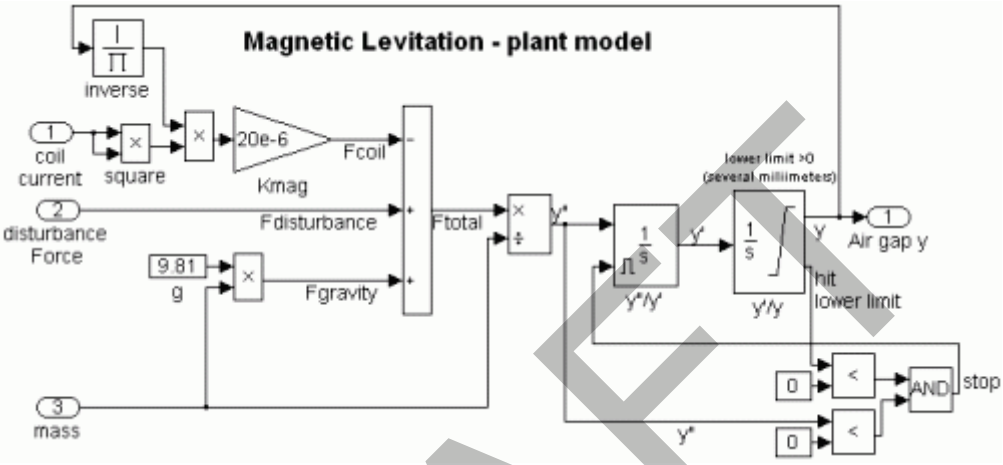

Fig. 4: Simple magnetic levitation simulation model

Fig. 5: Magnetic levitation real model for control methods testing

3.1 Construction material analysis - 3D printing

Because the proposed solution is based on levitation, caution is required when choosing materials for containers and the shelves. Used materials must not interfere with function, preferably nonmagnetic, however durable and sturdy. Plastics and carbon fibre materials exhibit these properties. For the prototype model, plastic is preferable, mainly because it can be manufactured using 3D printers. Also 3D printing offers exotic shapes to be manufactures, making prototyping of shelve locking mechanisms and asymmetric electromagnet housing with combination of embedding permanent magnets.
Such rapid prototyping is necessary for testing of correctness of magnetic field simulation. Mainly for the control process itself, there are parts which must be tuned on real model and cannot be properly simulated.

Grid shapes can be evolved using methods such as Grammatical Evolution for structure and HC12/GAHC for structure parameters tuning.

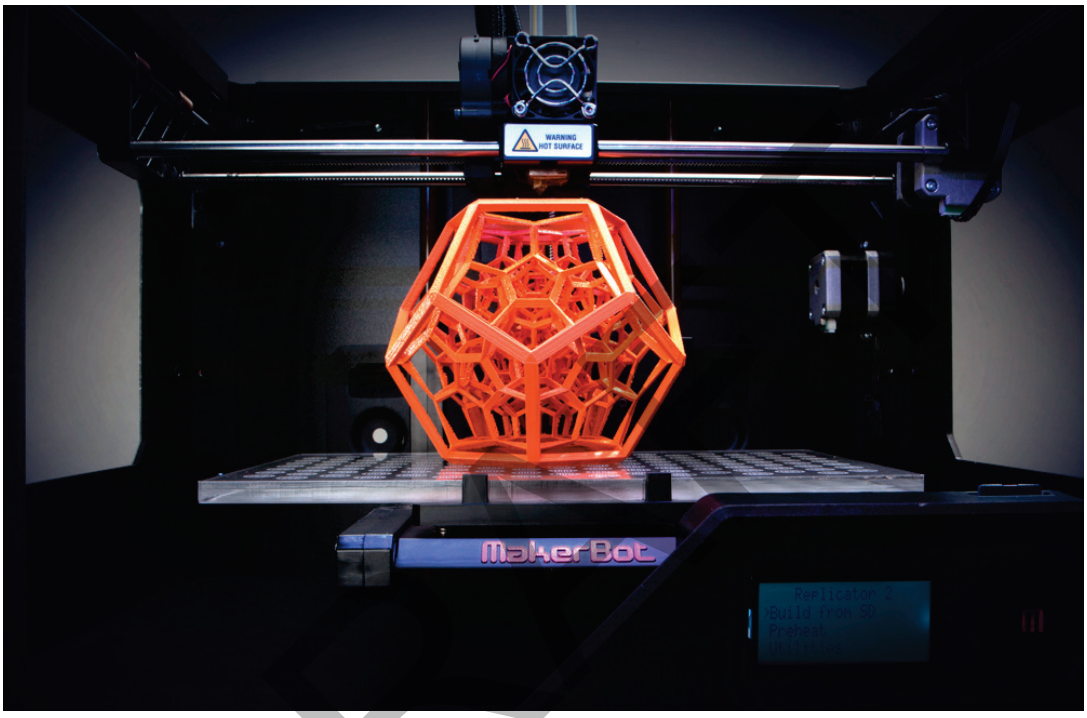

Fig. 6: 3D printing offers possibilities for manufacturing parts of unusual shapes [ref:wiki]

4 Conclusion

There is much left to explore in this solution, we have made progress by simulating some properties of such system. Advantages of such solution are many, such as low maintenance, compact construction and automatic cataloguing. The proposal opens research possibilities in magnetic levitation grids and new constructions.

Acknowledgement: Support for this paper is from Norway grants project NF-CZ07-MOP-3-202-2015.

References

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