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Variable Floor for Swimming Pool Using an Expert Svstem

Prof. Dr. Samy Abu Naser[1], Dr. Aeman M. Aead[2]
[1]*Department of Information Technology, Faculty of Engineering & Information Technology, Al-Azhar University, Palestine*
[2]*Department of Engineering, Faculty of Engineering & Information Technology, Al-Azhar University, Palestine*

ABSTRACT : *The indoor variable floor for swimming pool gives many possibilities of usages in the area where exists, for example, swimming pool, welcoming room, and sport hall. Therefore, we came to the idea of using the indoor variable floor for swimming pool due the shortages of open areas in Gaza Strip. The heating of the water in this pool when it is closed saves a lot of energy and time. During the winter season, people do not go the sea; but the can go to indoor swimming pools. The indoor variable floor for swimming pools can be built in schools for teaching the swimming courses for all ages of students. Since the depth of the water can be controlled, all students with different ages and classes can use the pool with high safety. To insure that, we designed an expert system to determine the height of the water in the pool according to some factors like: age, type usage, and time of the day. In the outdoor variable floor for swimming pool, it can be closed easily when it is not used to keep it clean and avoid falling kids in it.*

Keywords: *Expert system, movable floor, pool, variable pool, swimming pool.*

I. INTRODUCTION

The variable floor for swimming pool is categorized by the addition of an additional floor board on top of the existing floor, which can go up and down like a lift. This additional floor board permits adapting the depth of the pool for diverse usages. Therefore, depending on the selected elevation of the additional floor, your pool can be transformed into a paddling pool for children or a suitable space for sports hall [1,2].

In the uppermost position the variable floor becomes not only powerful security system for your pool, but also a part of the original courtyard that surrounds it. This is owed to the region of pool becoming entirely covered and inaccessible.

The variable floor is usually built by a structure of tubes and/or beams of stainless steel which are bolted or welded together into the shape of the pool opening. This structure is then covered by a finishing surface like: exotic wood, stone, tiles, PVC or mosaic [2, 3].

Variable floor is well equipped with a trap door to permit access to the bottom of the pool in order to perform maintenance or for regular pool cleaning.

The device works through an electronic control accessible only by keypad. You can visualize and operate the position of the variable floor inside the pool through a touch screen [4].

The open areas in Gaza Strip where we live is limited so, the variable floor for swimming pool is an ideal solution. That means when we need a swimming pool we uncover it and determine its depth according to the group of users and we need to use its space we cover it and use it for other non water activities and events.

We use an expert system that determine the depth of the variable pool according to may factors such as : time of day, age of users, school swimming, processional swimming, private Lessons, Swimming for Seniors, Synchronised Swimming, Diving, Hydro Spinning, and Mothers with Babies.

1.1 History of variable floor for swimming pools

The variable floor for swimming pool idea began in Germany about 40 years ago. The first variable floor in North America was built in the Olean, New York YMCA in 1975 [1, 4]. Variable floor pools were mainly used in rehabilitation centres, hospitals, colleges, universities, schools and private homes.

1.2 Benefits of variable floor for swimming pool

A good facility is essential to the proper development of sporting opportunities for everyone from young toddlers just beginning to top level professional athletes. Variable floor for swimming pool provides the opportunity to easily increase the capacity of a pool by providing the tools to run an efficient and well organized facility. By increasing the flexibility of the pool you will be able to increase your program options maximizing the appeal to your customers.

Variable floor for swimming pool is the solution to the impact of winter for pool. One can maintain the pools water temperature, thus rapidly paying off with a reduction in heating and water bills [4].

The surface of the variable floor of the swimming pool is a very important element. We have the choice of wooden decking, stone, tiles, PVC or mosaic surface. In order to correctly make the pool completely hidden, an identical surface to match the area surrounding pool should be selected. Small areas are able to accommodate a pool while still keeping a space for relaxation or guests.

II. METHODS OF MECHANISMS FOR VARIABLE FLOOR OF SWIMMING POOLS

There are a few methods of mechanisms for constructing variable floor swimming pools such as motorized variable floor of swimming pools and hydraulic variable floor of Swimming Pools.

2.1 Motorized System for Variable Floor of Swimming Pools

The innovative and economical motorization system makes use of water hydraulic principles to move the floor and is an integral part of the floor configuration itself. When pulled back, the profile of the Spiralift is included into the moving floor structure (low height) with no extra excavation necessary. All the equipment is intended to work in water, getting rid of the need for a dried up room to home additional machinery/cables. In fact, the whole drive system can be fixed into the floor structure proceeding to arrival on site [2]. Safe openings in the floor permit easy access to the drive for examination and maintenance as in fig. 1.

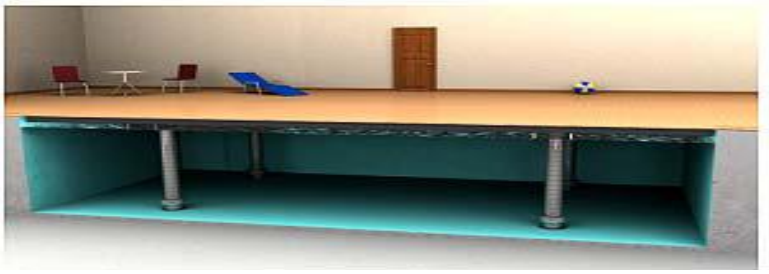

Figure 1. Motorized variable floor of Swimming Pool

Spiralift units can be optimally located precisely where essential for an perfect sharing of the load between the actuators. This keeps the structure as light and reasonable as possible with a least number of Spiralift units necessary per platform. All components are intended to ensure the firmness and constancy of the platforms without any "bounciness" and to hold up rated floor masses. Running the platform is simply done by means of a simple control [3].

2.2. Hydraulic System for Variable Floor of Swimming Pools

A hydraulic cylinder system with variable floor consists of: moving floor, supported by four hydraulic cylinders as seen in fig. 2. To adjust the depth of the water which are controlled by a control unit [2].

A hydraulic cylinder system with variable floor is very reliable, very strong, requires little maintenance, and appropriate for large pools.

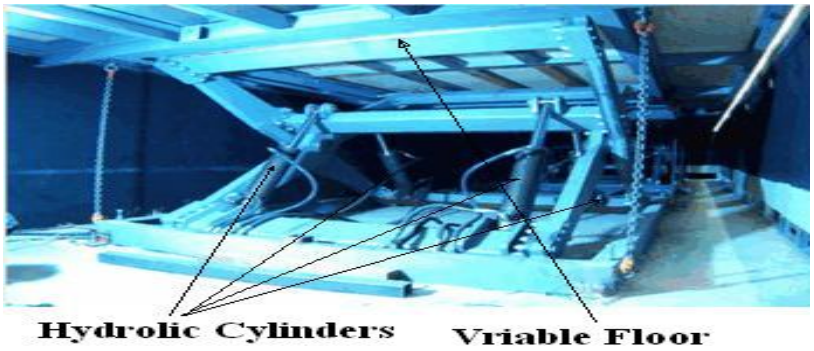

Figure 2. **Hydraulic variable floor of Swimming Pool**

2.3. Mechanical System for Variable Floor of Swimming Pools

The four lift arms connecting with two leading screws when closing the pool, moving up as shown in the fig. 3. The lead screw is driven by an electrical motor which located outside the pool. The depth of the water can be controlled by the number of revolutions of the lead screws [1].

Figure 3. **Mechanical System for Variable Floor of Swimming Pools**

III. EXPERT SYSTEMS

Artificial Intelligence (AI) was introduced in the 70s, the aim of AI scientists has always been to build up computer programs that can think and solve problems at the point compatible to human experts. An expert system is usually a computer program which performs tasks similar to the one performed by an intelligence human expert[8,9,10].

The term "expert system" could be applied to any computer program which is able to portray conclusions and make decisions, based on knowledge, represented as a database, it has. Expert systems usually consists of three core parts: User Interface, a knowledge base in certain domain and an inference engine which is a set of algorithms, which perform judgment and reasoning [11,12].

There are two stages during creating expert systems: data acquisition and reasoning. Data acquisition provides a way "to teach" a system, this results in a knowledge base, while reasoning is the major mode an expert system works in.

The performance of expert systems depends on their knowledge bases mostly [10]. It was expressed: "more knowledge less search", the more knowledge you have the faster you find an appropriate solution. So the main problem is to create a suitable knowledge base [10,11].

The expert system developed in this work consists of the user interface, the knowledge base, and the inference engine. The structure of the expert system is shown in Fig. 4.

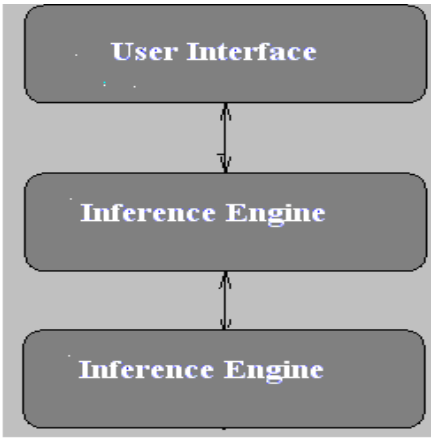

Figure 4. Structure of Expert Systems

The methodologies constitute the second generation of expert systems and they have the tendency to be developed to the direction of on one side directed also dedicated knowledge (expertise orientation) and on the other hand in the development of applications in specialized problems (problem - oriented). In the present research paper the problem of the variable floor for swimming pool are implemented by methodology of rule based expert systems. One of the well-know methods of representation of knowledge in the expert systems is the productive representation as the CLIPS (C Language Integrated Production System)[11].

CLIPS keep in memory a fact list, a rule list, and an agenda with activations of rules. Facts in CLIPS are simple expressions consisting of fields in parentheses. Groups of facts in CLIPS, usually follow a fact-template, so that to be easy to organize them and thus design simple rules that apply to them. Our expert system contains 37 CLIPS rules. An example of a rule in the expert system is shown in fig. 5.

```
(defrule sw-pool-cont-to-yes-branch
  ?nod <- (current-nod ?name)
  (nod (name ?name)
       (type decision)
       (yes-node ?yes-branch))
  ?answer <- (answer yes)
  =>
  (retract ?nod ?answer)
  (assert (current-nod ?yes-branch))
```

Figure 5. An example of a rule in the expert system

The goal of our expert system is to determine the proper height or the depth of the water in the swimming pool according to the following factors:

1. Time of the day: 8 am – 10 pm.
2. Usage of the pool :
   - Regular swimming
   - Teaching swimming
   - Professional swimming
   - Therapy swimming
   - Diving
   - aqua dance
3. Age of users
   - babies with mothers

- kids from 8-11 years
- teen age from 11-16 years
- Grownup 17 and up years

IV. USAGE OF VARIABLE FLOOR OF SWIMMING POOL

The variable floor allows the use of one swimming pool for a number of activities: water sport activates, none water sport activities, Social events, and reception hall.

4.1 Water Sport Activates

The variable floor of swimming pool can be used for many water sport activates like swimming competitions, baby swimming with their parents, aqua dance, disabled/remedial activity, swimming instruction, diving, activities that require different levels of water depth, water therapy , and school trips (See fig. 6).

For example: variable floor of swimming pool recognizes the value of a therapy pool for physical rehabilitation. Hydrotherapy pools require varying depths depending on the patients' disability, age and training activity. Because these treatments often take place in private, semi-private or small groups, variable floors can help achieve maximum results. They allow flexibility in size and depth but also support in operating the range of pool temperatures for specific kinds of therapy.

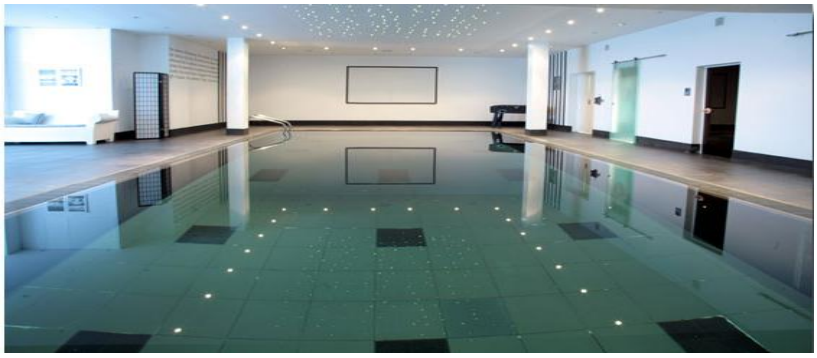

Figure 6: Swimming pool for water sport activities

4.2 None water sport activities

The pool can be converted to a large sport hall when making the height of the water to be zero and covering it by a finishing surface like: exotic wood, stone, tiles, PVC or mosaic. This large sport hall can be used for a number of different sports activities: including football, badminton, basketball and netball, and Ping pong (See Fig. 7).

Figure 7: Can be adapted to be used none water sport events

4.3 Social events

The pool and surrounding areas can be transformed into a stylish indoor exhibition area - making it perfect for social events, parties, weddings, concerts, meetings, Reception Hall, and presentations. Fig. 8 is suitable for all social events mentioned after little adjustment.

Figure 8: Can be adapted to be used as for social events

V. CONCLUSION

In this research paper, we have studied the benefits, usages and the mechanisms of indoor variable floor for swimming pool. This type of pools is very suitable for Gaza Strip. The area where the pool exists can be used for many purposes such as: water sport activities, none water sport activities, and social events. This type of pool gives the opportune to be used by all age groups all year round. In order to be suitable for all age groups, we designed an expert system to take into account all factors affecting indoor variable floor for swimming pool to determine the proper water depth of the pool.

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