AUTOMATIC INTEGRATED GLASS CLEANING SYSTEM DESIGN AND ARCHITECTURE

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Abstract

In recent years, with the rapid increase in high-level construction throughout the world, exterior cleaning of these structures has become important. Cleaners are still working on exterior and glass cleaning of high-rise buildings. This causes fatal work accidents or leads to various financial losses due to the failure of systems to be developed. Our project aims to make the cleaning process safer and faster by creating an integrated cleaning system on the exterior of the buildings. Considering that the Automatic Integrated Glass Cleaning System works on the exterior of the buildings, our priority will be to develop a safe system design.

Keywords: exterior cleaning, glass cleaning, accidents, financial losses, safer/faster.

INTRODUCTION

Cleaning every scene in our lives is a standard of everyday life, and it can be defined as a concept that also determines beauty in terms of visualise. From this point of view, the appearance characteristics of the first attention are very important. Higher level of cleanliness constitutes a serious problem and poses a danger to work safety.

To avoid such undesirable situations, automatic glass cleaning systems have been developed and continue to be developed. There is a lot of work done in this area. The first examples of antagonism are; Consists of systems developed for cleaning interior glass windows. Tohru Miyake and Hidenori Isihara (2003) have designed a small size and lightweight cleaning robot. The size of this cleaning robot they designed is 300 mm x 300 mm x 100 mm and the weight is about 3 kg. They used sensors that we can call distance sensor to determine the distance to the corners in these studies where they use an accelerometer to control motion direction. The purpose of this study is the experimental result of basic motion control and glass wiping motion of the cleaning robot system. [1]

Developed by Teodor Akinfiev, Manuel Armada and Samir Nabulsi in 2009. [2] This facade and glass cleaning system is not an integrated system, but the up and down control of the system is done by cranes on the building. Another example we have examined is the system developed in 2001 by Mongkol Jesadanont. [3] The system is not an integrated system as we designed it. Again, as in the previous example, the building is designed as a controlled crane. In this type of system, up and down movement is controlled by cranes with the help of ropes connected to the devices. Unlike the other systems in this system, there are pneumatic or vacuum mechanisms for adhering to the glass surface. A system structure driven by the crane system is given generally. This machine weighs 125 kilograms; The brush size is 1000mm, the wiper size is 1500mm. The climbing speed of the machine, which has a movement capacity of 300 meters, is specified as 8m / min. [4]

Another example is the integrated surface cleaning system of iku-windows which is being used today. [5] For the operation of this system, it is necessary to equip the building exterior with hardware products of the system. In this system the movement is made by a belt system driven by the engine. This system has a movement length of 60 meters. [6] From the many systems built in this area, the project creates an intelligent glass cleaning system design integrated with the exterior, which can work independently or manually. In particular, the number of high buildings which have increased rapidly in recent years considers the necessity of this project. [7]

Exterior facade coatings in high buildings are usually made of glass, but the cleaning of these glasses is still carried out by using human power especially in the developing countries. However, this poses a risk especially due to working at high and sometimes threatens the safety of employees. In addition, cleanings done with human power last many days and disturb visibility in specially designed buildings. [8] First of all with our project; We tried to design a system that can remove hazardous situations, loss of life and property from the point of view of work security and then clean glass and exterior structure more visually and structurally integrated with buildings, faster than human power Taking into consideration the availability of all these features as well as the availability, we have taken care to use the materials that will give the best performance. [9]

MATERIALS AND METHOD

We made our drawings in the Solidworks program to create the system prototype we designed from the examples we have examined in the literature. In general, the design of the system consists of a mechanism that moves up and down on a glass consisting of two profile frames. Some of the materials used in system design are designed from our side using some examples (erasing mechanism), some of which are made up of ready-made models in terms of convenience in case of switching to production. The application of some regions may vary, considering the fact that the prototype will encounter various faults during physical model casting.

These mistakes there may be tolerance errors due to human-induced shifts or material constructions. In the event that such mistakes do not escape excessively, the effect on the entire system can be ignored. For this reason, there are various changes in the dimensions of the materials when they are poured into the design. In our project which we have created as an original design, it is planned to use 3D printing technology in general for the prototype production plan. The part shown in Figure1, which forms the cleaning part, is designed in accordance with the 3-D edition. The parts required for our partly designed system can be assembled and prepared after 3D printing is received. Parts which are difficult or costly to produce by 3D printing can be cut from Plexiglas material. These materials are left to the person who will form the preferred prototype design. In the following sections, the overall installation of the system will be explained step by step.

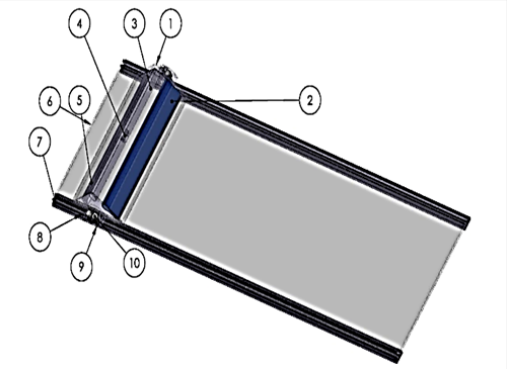

Figure. 1. *System and material used*

Table. 1. *lists the materials needed for our prototype.*

Part number	Part name	Number
1	Cleaner mechanism	1
2	wiper	1
3	Air conduit	1
4	Air transfer engine	1
5	Water sprayer	1
6	Plexi glass pine	1
7	Cargo profile	2
8	Flat rack	4
9	Rack gear	8
10	engine	4

A general view of the system we designed in Figure 1 appears. Here, the parts used in the system are numbered. In Table 1, it appears which numbers the numbers represent.

CAD INSTALLATION OF SYSTEM

We first started with the design of the glass, which would allow the cleaning device to move easily on the design of the system. After reviewing the various profiles on the market, we designed a profile that would allow the hose and cables to easily accommodate the water and electricity needs of the cleaning system. The ducts on the inside of the profiled profile are prepared for hose and energy cables.

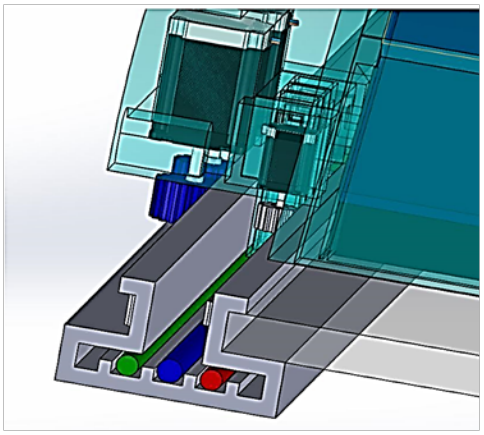

Figure. 2. *Sample wiring image*

Figure 3, shows a side view of the cleaning system we have designed.

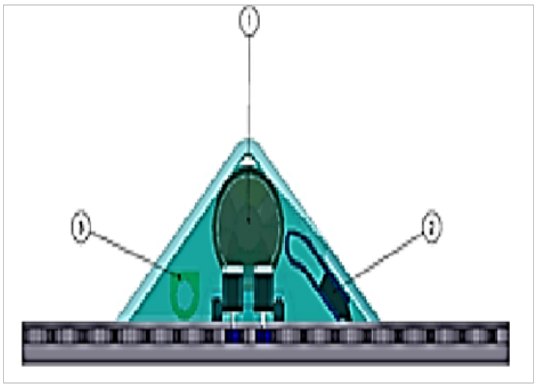

Figure. 3. *Side view of the cleaning system.*

There is an air duct designed for drying in the area on the right side of track number 1. Air entry into the system is through the air gap at the top of part 1. The incoming air is transmitted to the glass surface through the channel with high-powered fans.

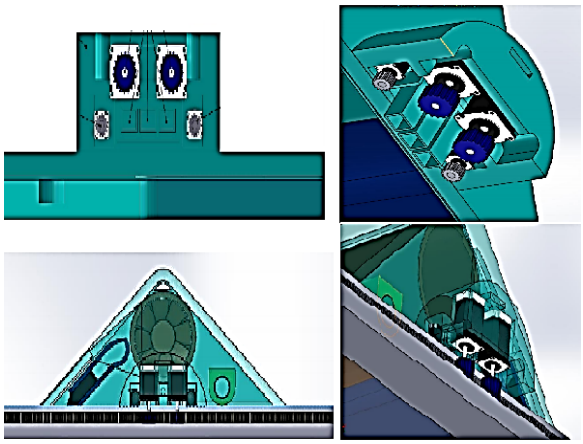

Figure. 4. *Overview of the assembled system.*

Details of the installation, wiring view and motor connections below the connection apparatus designed in the system are given. The apparatus connected to the cleaning system provides the movement of the system, the motors to be connected to the system. The use of carrier load in the system is considered appropriate in order to prevent excessive load on the motors during system movement. As a result of the assembly process in the prototype CAD design, the system can be moved with a flat rack and gears. It is possible to reshape by designing according to the materials that can be provided during the prototyping stage.

The connection diagrams and important parts of our project drawn in Cad program are shown in different angles given in figüre 4. Colors and sizes are randomly drawn and cable routing may vary during prototyping. The electric cables and hoses that will send energy and water to the system will pass through these channels which are opened in the prototype. The project we designed has 5 channels. One channel for water and one fan for motors and 3 channels for motors was considered sufficient, but additional channels were added to the system considering that it might be needed in case of any addition to the system.

WORKING PRINCIPLES

To briefly describe the operation of the system: The up-down movement will provide 4 motors with energy from the drive via the controller. First, the high-pressure cleaning fluid will be sprayed onto the surface through the fine holes on the sprayer we designed. The engines will then start moving downwards and gradually descend towards the bottom. The dirty surface will be stripped away from the dirt during the movement. The high-powered fans will dry the glass that has been wiped off with the help of ducts.
Thanks to this project, even if the buildings are very tall, the exterior cleanliness of the facade will not require human power and all exterior cleaning will be done by such and such systems. Findings and Evaluation We compare the system we have designed with the systems we have examined in the literature review, and we can see the advantages and drawbacks. The reason for choosing an integrated system; It is planned that the surface cleaning to be done will give better results. One of the general negatives that we have detected in the systems controlled by the crane can be shown to be good cleaning by staying away from the surface in some areas. In addition, the cleaning process is a long process that is not visually appealing.
In addition, systems controlled by crane can be affected by natural conditions such as wind, especially in high buildings and may damage the building exterior ceiling. Since these systems, which have high weights, are not specially designed for the building, it is possible to encounter various problems during application. The crane-assisted cleaning systems specially designed for the building will not solve the other problems mentioned above even if some problems go away. Another example of an integrated cleaning system is widely used in many buildings

CONCLUSION

With the integrated glass cleaning system we designed, we aimed to reduce the use of human power to eliminate the risk of various work accidents, especially in exterior facade cleaning work in high buildings. Thanks to these integrated systems that will be installed in high buildings, the cleaning process will be done more safely and faster.

Even if it seems to be high in terms of cost, considering the accidents or loss of life that can occur in the cleaning works made by using human power, there is no high cost cost. In addition, the cost will be amortized over time in systems that will be designed with high strength and high performance. The only costs that can be incurred outside of these systems will be maintenance costs that will be made at regular intervals.

The choice of an integrated system will result in a high initial installation cost. Because the systems we have designed are integrated in every glass. With a few modifications to the design, the cost can be reduced, but the effect on the system safety must not be overlooked. Considering that the cost of these systems to be used in large projects will be a small number in addition to the project costs, it is obvious that the preference will increase.

ACKNOWLEDGEMENTS

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