

**Research Article****Design study with height adjustable washbasin****Süleyman Çınar Çağan <sup>a,\*</sup>, Berat Barış Buldum <sup>a</sup> and İskender Özkul <sup>a</sup>**<sup>a</sup>*Mersin University, Engineering Faculty, Department of Mechanical Engineering, 33343, Ciftlikkoy, Yenisehir/Mersin, Turkey*

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## ABSTRACT

According to Turkish Statistical Institute data (2011), it is known that approximately 6.6% of the population in Turkey is composed of disabled people and the highest rate of disability is from physical disabilities. It is observed that the freedom of movement of physically handicapped individuals is very limited in the environment and housing areas, and the existing regulations do not fully respond to the needs. It is difficult for people with physical disabilities to use furniture, fixtures and fixtures designed for normal people. The washbasins in bathrooms and toilets, which are the most special parts of homes and workplaces, need to be arranged for individual use without physical support for individuals with physical disabilities. In this way, disabled individuals will be able to live their lives without the need of others, at least by labor. In this study, a height adjustable washbasin was designed as a solution to minimize the difficulties caused by arrangements in the wash basin in bathrooms and toilets, one of the places where disabled people are most distressed in living spaces and public spaces. This study has been designed and manufactured not only for disabled people but also for the children and the elderly, especially those with physical competence, which will facilitate the life of each individual.

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**1. Introduction**

According to the World Health Organization; "Disability; a deficiency or disability means a disadvantageous situation that prevents and restricts the ability to engage in activity on a particular person and which may be regarded as normal according to the age, gender, social and cultural status of that person" [1, 2]. A person with a disability is defined as a person who is in need of protection, care, rehabilitation, counseling and support services because he or she is unable to meet the requirements of normal life due to loss of physical, mental, emotional and social skills after birth or afterwards [3].

Approximately 6.6% of Turkey's population is said to consist of people with disabilities [4]. Hospitals, schools, universities etc. are required to carry out studies to address the needs of individuals with disabilities [5]. The design of household appliances, furniture, etc., has a great prospect among these works so that people can live on their own without needing anyone. Urban design approaches have begun to be adopted in order to enable people to live in the street as well as to live on the street in the same way and

to be able to experience the freedom in the house in the same way and sensitive approaches to disability are planned in the planning of physical spaces such as buildings, buildings, streets, pedestrian roads, transportation networks [6]. The city plans pioneered by the European countries have become an example to other countries, and over time, "disability" has begun to take place among the city plans and strategic plans of many countries [7]. In order to reduce the difficulties of people with disabilities in their daily lives, it is of significant importance that the washbasins in bathrooms and toilets are made suitable for their use. Elevation is one of the most important parameters in the design of the washbasin. People need to go to a stand-by position in order to use the washbasin, depending on their length and the activity to be performed. The effect of height on human health is very important in this context. In addition, the height adjustable washbasin design will allow children to get cleaner education at a young age and make it easier for the elderly to use the washbasin. In this study, it was aimed to ergonomically design washbasins in bathrooms and toilets that are frequently used by children, elderly people,

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especially disabled people, in their living spaces. For this; height adjustable washbasin design. In this way, it has been tried to design a design that will facilitate the life of each individual who has physical disabilities, especially disabled individuals, children and the elderly.

## 2. Literature Research

Height adjustable washbasin design; are necessary to improve the living standards of disabled people, children and the elderly. In a study by Moon and Bae [8], a height-adjustable washbasin-based design was developed based on Korean anthropometric data. Using the human model, waist movements were examined when subjects performed hand and face washing movements. A prototype from the test results was made and a confirmation test of the guide was carried out using a height adjustable washbasin and it is reported that the height adjustable washbasin is more beneficial for people with disabilities when compared to a conventional washbasin at constant height. In a study by Goto and his colleagues [9], they conducted a study on whether the existing washbasin heights are still valid with rapid aging in Japan. During the face wash, both the tap and the cabinet were tested to examine the preferred height. Senior people were asked to wash the face without any compulsion and the preferred height was determined. According to this study, you have observed that the current height is below the acceptable level. The height of the washbasin is closely related to the moment applied to the users' pools [8]. Posture; the lower position forms a large gap between the elbow and the washbasin, so that the user has to bend the upper body forward (Figure 1). While designing the washbasin; it is very important for the health to choose the height adjustable washbasins according to the standard size washbasins which cause the increase of the applied torque. In a study by Rashid and his colleagues [10], it was designed to provide an ergonomically comfortable environment for older Malaysian people. 10 houses were taken as samples and the anthropometric studies were done according to the Malaysian living area designs.

Awang et al. [11] has been studied on medical application designs for hospitals. This study covers the design of buildings for use and care of disabled people in Malaysian hospitals. As a result of these studies, the use of washbasins and lifts of disabled people is a very critical situation.

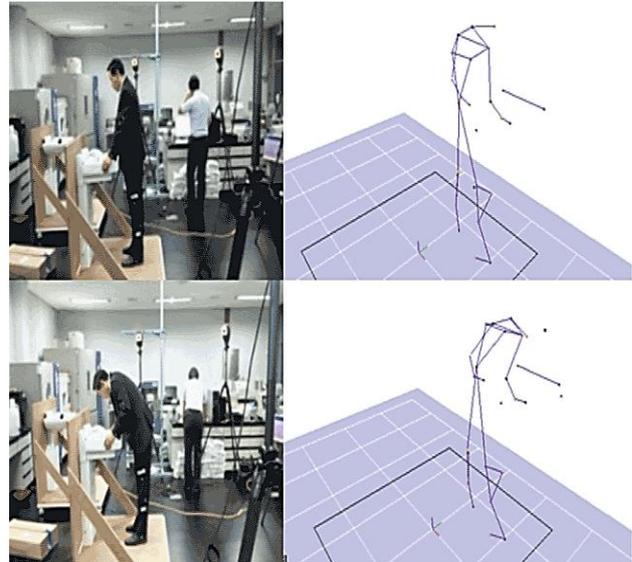


Figure 1. Data obtained by motion: standing and bending body [8].

## 3. Material and Method

The design of the standard washbasin was inspected and the technical drawing of the washbasin was drawn (Figure 2). The technical drawings are manufactured one by one and the assembly process is carried out and the height adjustable washbasin design is completed.

The way to follow in experimental work is:

- The initial height of the adjustable washbasin should be set to the average of the elbow height.
- The person has to show the process of washing his face in the standing position.
- 3dimensional motion capture system should measure the body and neck inclination angle.
- The moment force applied to the waist of the individual should be calculated.

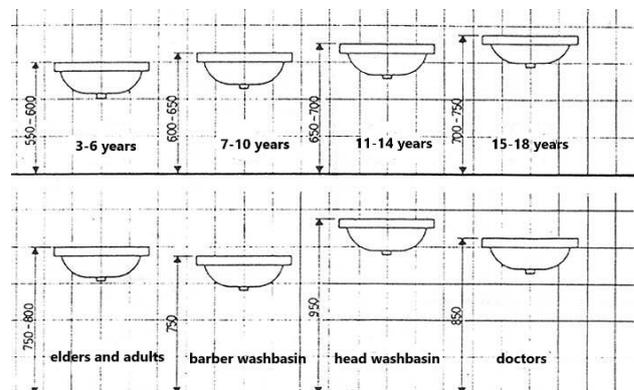


Figure 2. Standard washbasin measurements

### 3.1. Design Components

In this study, height adjustable washbasin design steps; drawings of technical drawings, selection of materials of

technical drawings, production of materials and assembly of manufactured parts.

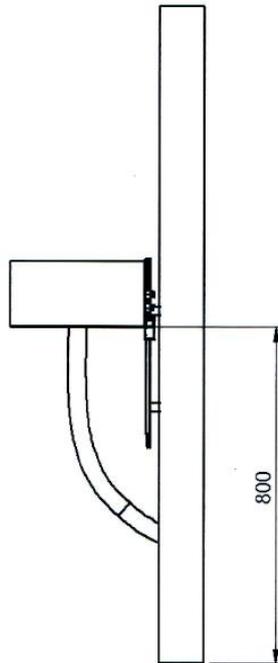


Figure 3. Technical drawing of the designed washbasin

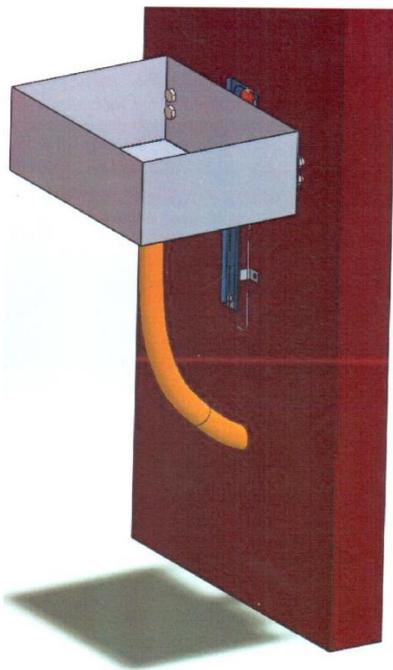


Figure 4. Installation image of the designed washbasin

In the manufacture of height adjustable washbasin design parts; 304 stainless steel was designed using washbasin as shown Figure 5. It has a design that can move up and down with 220 V. Dimensions are 750 x 590 x 700 mm and weigh about 36.1 kg (Sack weight = 19,9 kg / load-bearing construction weight = 16.2 kg).



Figure 5. General washbasin perspective view

### 3.2. Actuating Mechanism

In our design, the actuating mechanism was preferred as like car window pulley system as presented in Figure 6. Car window pulley system actuated with 12V DC brushed motor. The speed of the washbasin can be arranged between 0-0.3 m/s. That provides speed control for DC motors with Pulse Width Modulation (PWI) unit. That can be arranged if user demand to change the speed for washbasin. Electrical panel is managed by Central Processing Unit (CPU) which can be found cheap and easy from market as shown Figure 7. The CPU board like as Raspberry, Arduino etc. supports many auxiliary sensors and wiring options. So, that allowed us to enrich our design to make more comfortable product. We have used photocell sensor to detect a person which ready to use washbasin. Two options provided the users to define the height of the washbasin. One of this is manual height arrangement system. That can be controlled by a push button which has "0", "1" and "2" as demonstrated Figure 8. "0" indicate upside, "1" neutral and "2" downside on the button. The washbasin should be pressed on the button to reach the desired height. In this option, against to over travel for washbasin, the system was taken the safe with limit switches. In Figure 9. shows the selection button for manual and automatic option for height level. In order to prevent any electrical danger and damage we have use emergency button (Figure 10).



Figure 6. Actuating mechanism for washbasin

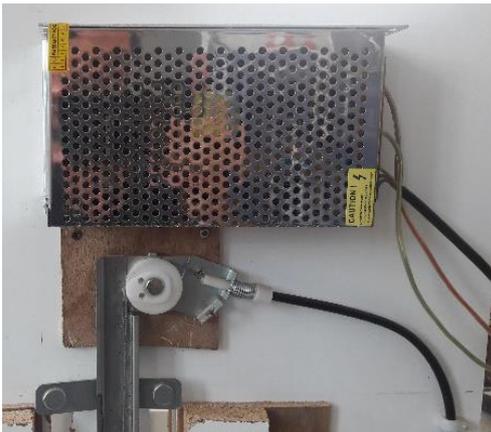


Figure 7. Electrical panel



8. Up down push button for height arrangement



Figure 9. Manual and automatic option for height level arrangement



Figure 10. Emergency button

#### 4. Conclusions

In this study, a height adjustable washbasin was designed. A prototype has been developed considering the literature data. The height adjustable washbasin design compared to a conventional washbasin at constant height; disabled people, children and the elderly. It is regarded useful to consider anthropometric data for future designs of this topic. The system has been developed with electronic CPU platforms and supported with different sensors. The electronic components usage made the design more comfortable and ergonomic for last users. The speed of the washbasin can be arranged between 0-0.3 m/s. Users and device safety were provided emergency button limit switches. Hence, this design was prepared as user friendly and ergonomic device.

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Figure

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