

# Automatic Ablution Machine using Vision Sensor

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**Abstract**— Water is something that is so cheap yet we take it for granted, but we need to conserve this life-sustaining resource. Based on research, a Muslim will use six to nine liters of water during abluion, adding that only two liters of water was used for the whole ritual. Because of that we need a machine that would enable Muslims to save water every time they perform the pre-prayer cleansing ritual. This machine allowed a Muslim to perform the cleansing ritual without water spillage and is environment-friendly as it encouraged water conservation. This machine use camera as sensor and servo motor as an actuator that is embedded on crane to turn and open it based on and object under the crane. It means that if there is an object under the crane, it will be opened, and when there is no object under the crane, it will be closed. Not just open and close the crane, we also use an adaptive method that detect how much water that Muslim need in abluion, example the amount of water that is needed for rinse the mouth of course is more than wash the nose. Not only for abluion, this machine can be implemented in every field, hand wash, kitchen, bathroom, wherever place whether there is crane there in order to protect water and environments.

**Keywords**— automatic abluion machine, computer vision, skin detection.

## I. INTRODUCTION

The Prophet, peace be upon him, said 'cleanliness is half of faith'. Muslims must be clean and wear good clothes before they present themselves before God. The Prophet also said "If there was a river at the door of anyone of you and he took a bath in it five times a day would you notice any dirt on him?" His companions said, "Not a trace of dirt would be left." The Prophet added, "That is the example of the five prayers with which Allah blots out evil deeds." (Bukhari). Ablution (called "wudhu") is the ritual washing performed by Muslims before prayer. Muslims always follow the example of the Prophet. He usually extended the washing ritual to ensure cleanliness before prayer, and even used to brush his teeth before each prayer.

Water is something that is so cheap yet we take it for granted, but we need to conserve this life-sustaining resource. The increasing human population and degradation of biological integrity of ecosystems has been expressed, to a great extent, as a decline in water resources, the most critical factor to achieve sustainable development [1]. Because of that we need a machine that

would enable Muslims to save water every time they perform the pre-prayer cleansing ritual without water spillage and is environment-friendly as it encouraged water conservation.

Prominent Egyptian scholar Sheikh `Abdul-Khaliq Hasan Ash-Shareef said he sees nothing wrong in using a machine as long as the basic pillars and requirements of abluion are strictly observed in a right and precise way. He said Muslims should not allow themselves to be distracted by the modern means, and they should not show laxity in achieving spiritual elevation while embarking on using such modern devices. "Muslims who use this kind of washers should not forget that they are actually performing a worship act and not a routine act of washing bodily parts," he stressed. "For example, it has been authentically reported that one's sins are forgiven when the drops of water drip from the organs of the person performing abluion. "This spiritual aspect of abluion and other aspects should be present in one's mind and should in no way be absent"[2].

We built an automatic abluion machine using camera as sensor and servo motor as an actuator that is embedded on crane to turn and open it based on and object under the crane. It means that if there is an object under the crane, it will be opened, and when there is no object under the crane, it will be closed. Not just open and close the crane, we also use an adapted method that detect how much water that Muslim need in this ritual, example the amount of water that is needed for rinse the mouth of course is more than wash the nose. Now a day, some people have invented the early automatic abluion machine, but when it is commercialized the price is so high, and only rich people or big mosque can buy it. Because of that we built an automatic abluion machine that easy, cheap, and multipurpose. Not only for abluion, this machine can be implemented in every field, hand wash, kitchen, bathroom, wherever place whether there is crane there in order to protection the water and environments.



Figure 1. Ablution ritual performed by Muslims before prayer

## II. AUTOMATIC ABLUTION MACHINE

Nowadays, some people have been invented the early automatic ablution machine. One of the automatic ablution machines is Auto Wudu' Washers (AWWs) the world's first automatic wudu' (ablution) and drying machine. The AWWs is made of a purpose built ear, mouth and facial washer unit, a forearm and elbow washing unit and a foot and ankle washing unit all of which are incorporated in a single system. The machine is fully computerized and operated by infrared sensors. Anthony Gomez, inventor and designer of the new infrared-operating machines and the Chairman and Managing Director of Australian AACE Worldwide PTY Ltd. Company, said no price has been fixed yet for the machine, but it would be "affordable." He decided to produce a sophisticated wudu' machine based on state-of-the-art technology to ensure water and time efficiency.



Figure 2. Auto Wudu Washers © (AWW).

The new machine is (Figure 1) fully computerized. "You don't have to touch any tap but it is operated by infrared sensors based on Australian technology". Main features of this machine are state of the art technology, washes and dries automatically, clean and hygienic, no water spillage, facilitates quick efficient washing, prevents overcrowding in wash rooms, ergonomic design, user friendly, low maintenance, easy installation. This machine made in Australia (U.S Patent Pending) Endorsed and approved by the Islamic Council of New South Wales, Australia (Member of the Arab Chamber of Commerce Australia). The Islamic Council of Australia has issued a fatwa approving the new machine [3].

## III. SKIN DETECTION METHODE

*Skin detection is employed in tasks like face detection and tracking [4], naked people detection [5], hand detection and tracking [6], people retrieval in databases and Internet, etc. However, skin detection is not robust enough for dealing with some real-world conditions, like changing lighting conditions and complex background containing surfaces and objects with skin-like colors. This situation can be improved by incorporating context information in the skin detection process. [7]*

The aim of skin color pixel classification is to determine if a color pixel is a skin color or non-skin color. Good skin color pixel classification should provide coverage of all different skin types (blackish, yellowish, brownish, whitish, etc.) and cater for as many different lighting conditions as possible. In the past, different color spaces have been used in skin segmentation. In some cases, color classification is done using only pixel chrominance because it is expected that skin segmentation may become more robust to lighting variations if pixel luminance is discarded [8].

Hands recorded under natural environments are frequently subject to illumination variations which affect their color appearance. This is a problem when the color cue is used to detect skin candidates at pixel level. Traditionally, color constancy has been suggested for correction, but after a lot of effort no good solution suitable for machine vision has emerged. However, many approaches have been proposed for general skin detection but they are typically tested under mild changes in illumination chromaticity or do not define the variation range. This makes it difficult to evaluate their applicability for objects under varying illumination.

YCrCb is an encoded nonlinear RGB signal, commonly used by European television studios and for image compression work. Color is represented by luma (which is luminance, computed from nonlinear RGB, constructed as a weighted sum of the RGB values, and two color difference values Cr and Cb that are formed by subtracting luma from RGB red and blue components. Colors are specified in terms of luminance (the Y channel) and chrominance (Cb and Cr channels). The transformation between YCbCr and RGB is linear. The transformation simplicity and explicit separation of luminance and chrominance components makes this color space attractive for skin color modeling [9]. The equation can be seen below.

$$\begin{aligned} Y &= 0.59G + 0.31R + 0.11B, \\ Cr &= 0.713 * (R - Y), \\ Cb &= 0.564 * (B - Y). \end{aligned} \dots\dots\dots (1)$$

$$Scale = \sqrt{(Cr - \overline{Cr})^2 + (Cb - \overline{Cb})^2} \dots\dots\dots (2)$$

In this paper, we investigate skin detection method by using RGB to YCrCb conversion [10] will define skin of human in different lighting condition. After that, the scale of image is got to make a threshold between the skin and the others. The number of skin-pixels that affects the number of water that flowed by pipes.

#### IV. SYSTEM DESIGN

The next section introduces the system design of this machine that divided into two sections. First is hardware design and second is software design.

##### A. Hardware Design

First, we built mechanic and hardware design to implement Automatic Ablution Machine system, block diagram of system is shown in Figure 3.

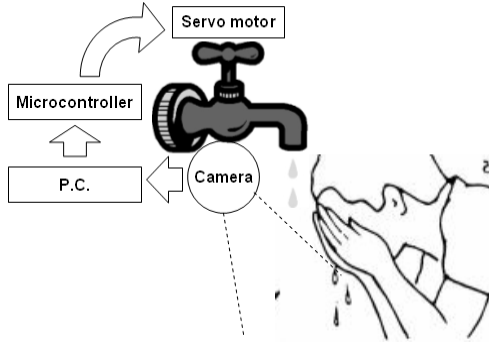


Figure 3. Block diagram of the system.

The system is divided into several sections: sensor and actuator selection, mechanical and hardware building. We use Logitech Quick Cam E-3500 Plus PC Camera as a sensor. For the actuator, we select standard servo-motor (180 degree rotation) type Hi-Tech HS-322, and Atmel ATmega8535 microcontroller for the controller with 9V voltage. The prototype of the system can be seen in Figure 3 and Figure 4.

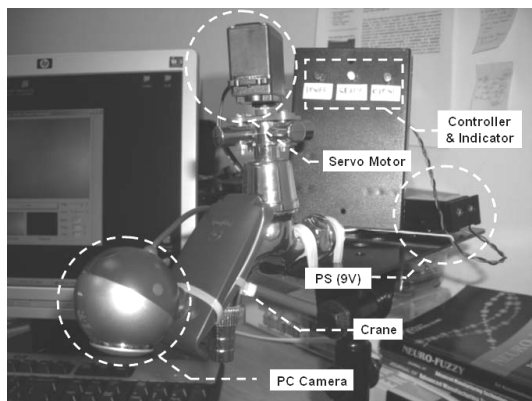


Figure 4. Hardware specification of the system.

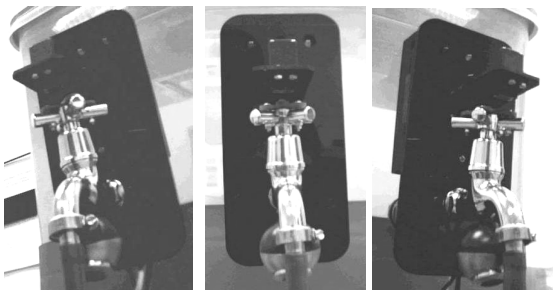


Figure 5. Prototype of ablution machine.

##### B. Software Design

Skin detection method models the color by using RGB to YCrCb conversion that can define skin of human in different lighting condition. After that, the scale of image is got to make a threshold between the skin and the others. In general, the algorithm of Automatic Ablution Machine shown in Figure 6.

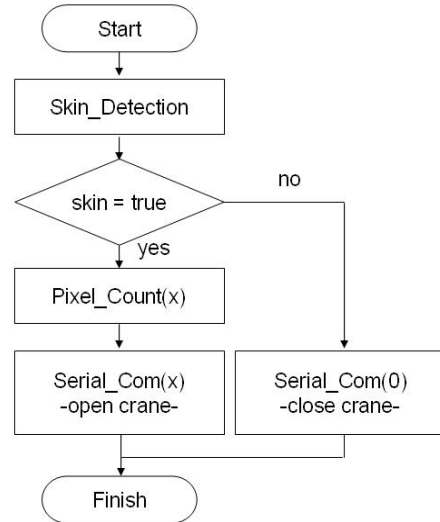


Figure 6. Algorithm of the system.

The graphical user interface (GUI) for this system, can be seen in Figure 7.

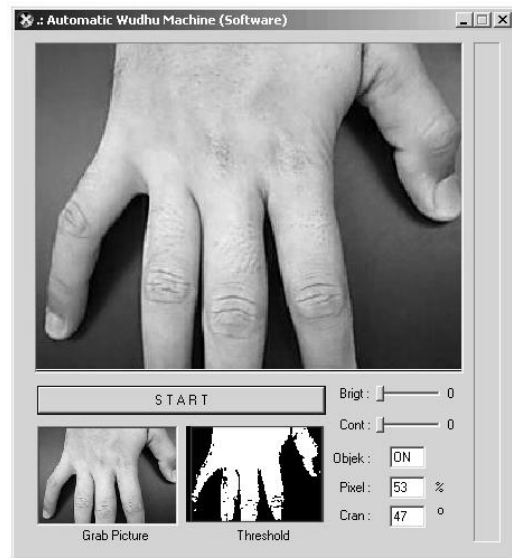


Figure 7. Software using DirectX 9.0 Direct Show: StillCap

There are some function on this GUI, there are:

- Bright : setting brightness of picture.
- Cont : setting contrast of picture.
- Object : showing if there is human skin.
- Pixel : showing percents the pixel of object.
- Crane : showing degrees the crane opened.

Figure 8 shows several skin detection results that have been grabbed when abluition.

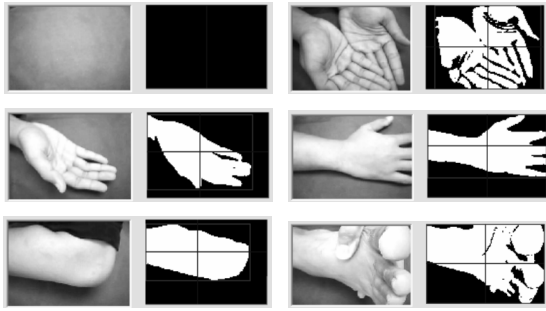


Figure 8. Sample of capturing human skin in several skin objects. (blank, two hands, one hand, arm, elbow, foot).

### V. EXPERIMENT & RESULT

The vision system has tested and implemented to the actual conditions. Figure 9 show many different water consumption type of people during abluition comparing with automatic abluition machine. People usually consume three to nine liters of water during abluition, when they use this machine they needs two to three liters of water was used for the whole ritual. With this machine, people will save one to seven litters during abluition.

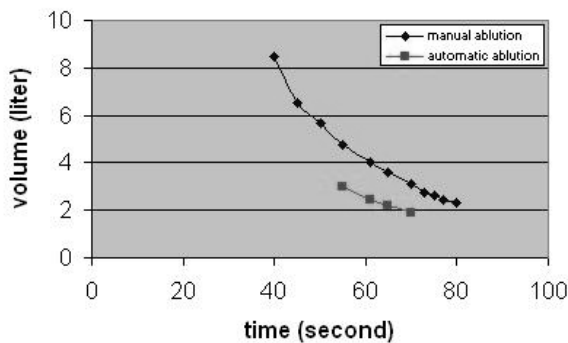


Figure 9. Water consumption during abluition comparing manual and automatic abluition.

### VI. CONCLUSION

Based on research, a Muslim will use six to nine liters of water during abluition, adding that only two liters of water was used for the whole ritual. With this machine, people will save one to seven litters during abluition. Not only for abluition, this machine can be implemented in every field, hand wash, kitchen, bathroom, wherever place whether there is crane there in order to protection the water and environments.

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