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Solar Powered Sound Automated Male Pee Toilet System for Protection against Coronavirus

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Abstract: The emergence of the Coronavirus disease altered a lot of things about 'life as we know it'. People mourned (and perhaps are still mourning) the loss of loved ones and efforts by the government to curtail the lethal spread has consequently destabilized the world's economy, challenged the healthcare systems of many nations, shut down public gatherings, displaced many people from work, and separated many friends and families. The world is essentially in a state it has scarcely ever been. Various researches have proven that the virus is primarily spread via close contact with infected persons or touching contaminated surfaces. So it goes without saying that public toilets with urinals and sinks have a high chance of spreading this virus as people have direct contact with surfaces like the tap head, toilet lids, flushing and door handles and the likes. The natural thing to do in this time would be to avoid contact with these places as much as possible. This is why the solar powered sound automated male urinal was invented, ensuring better protection against Covid-19. It was designed and constructed with electronic sound actuated circuit, sound sensor, electronic pumping machine, male urinal pot, plumbing materials and powered with 12 and 9 volts DC battery incorporated with solar power for uninterrupted power supply. Its flushing and rinsing time is set to 11 seconds, using suitable electronics components. This automated urinal is an essential for public schools, business organizations and larger firms during this period in order to control or even prevent the spread of Covid-19. It is portable, unique and easy to install. This research work was sponsored by Science Technology Department and was officially presented before the Rector and the management of Federal Polytechnic, Offa on Monday, the 1st of June, 2020 as a part of the Covid-19 preventive intervention through the Technical Committee on Intervention and Containment of Covid-19 of the Science Technology Department.

Keywords: Pandemic; Coronavirus; Urinal; Infection; Automated; Containment.

I. Introduction

The emergence of the Coronavirus disease altered a lot of things about 'life as we know it'. People mourned (and perhaps are still mourning) the loss of loved ones, efforts by the government to curtail the lethal spread has consequently destabilized the world's economy, challenged the healthcare systems of many nations, shut down public gatherings [16], displaced many people from work, and separated many friends and families. The world is essentially in a state it has scarcely ever been. [4]. Historically, this pandemic situation is similar in effects to World War II and it has already imprinted itself upon the nation's psychological frame, nearly collapsing many health care systems and businesses around the world [4]. Coronavirus, known as an infectious disease caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [8], was first identified in December 2019 in Wuhan(a city in China), Hubei province to be precise, and it has since spread across most parts of the world, hence, the ongoing 2019-2020 Coronavirus Pandemic [6, 12]. Its common symptoms include fever, cough, shortness of breath, fatigue, muscle aches, diarrhoea, sore throat, loss of smell, and abdominal pain [3, 13, 5]. Its incubation period from the time of exposure is typically around five days but may range from two to fourteen days [3, 10]. Many of its cases result in mild symptoms, while some progress to viral pneumonia and multi-organ failure [6]. An epidemiological study shows that the virus is primarily spread via close contact with infected persons, touching contaminated surfaces, and more often via small droplets produced by infected persons during coughing, sneezing, or talking [1, 15]. Studies also reveal that they are not infectious over long distances. This is why social distances prevent the spread when these droplets are produced and fall to the ground or onto surfaces rather than the nearest person [2]. People may also become infected if they touch surfaces that have been contaminated by infected people and then touch their eyes, nose, or mouth [13]. Experimental studies show that the virus cannot survive on surfaces for up to 72 hours [9]. Its concentrations are usually very high and most contagious during the first three days after the onset of symptoms, although spread may be possible before symptoms appear and in later stages of the disease [15]. Some of the

recommended measures to prevent infection include: frequent washing of hands, maintaining physical distance from others(particularly from those with symptoms), covering coughs and sneezes with tissue or the inner elbow, and keeping unwashed hands away from the face [11]. Also, the use of face masks is recommended for those who are suspected of having the virus [2]. The frequently washing of hands is primarily to prevent the spread the spread of the virus between people in close contact (e.g. handshaking) or after contact with surfaces that have already been contaminated by infected people, especially in public toilets. As stated earlier, reference to [1, 15], the virus is primarily spread when there is close contact with infected people or surfaces, this makes public toilets, particularly those in small building with urinals and sinks used by the general public high risk areas. These public toilets are some of the places expected to practice and perform high level of hygiene in order to maintain good health and avoid contamination [14]. This is required because toilets are essential and flushing after use means touching the flush knobs which if contaminated can lead to the transfer of Coronavirus. This is why introducing and incorporating electronic urinals will to a very helpful extent, protect by displacing the need to makes direct contact with contaminated surfaces. These electronic urinals are actuated by sound and it automatically flushes the urine out after usage. This project is titled "Solar Powered Sound Automated Male Pee Toilet System for Protection against Covid-19". With reference to the work titled, its design and construction basically required the field of physics and electronics circuit incorporated with sound sensor, solar power for continuously powering the system and electronic pumping machine to supply water for rinsing and flushing after use at a pre-set time.

II. Materials and Method

To realize the invention of the solar-powered sound automated urinal, it required four main sections: design and construction of electronic sound actuated switch circuit, solar power section, amalgamation of urinal, plumbing material and other parts of the toilet, and finally the casing and packaging of the entire unit. The fundamental components for its effective functionality are: electronic pumping machine, urinal, plumbing, solar photovoltaic system, solar charge controller, electronics switch and sensor, deep cycle battery and mechanical casing as discussed below.

Electronics Sound Actuated Switch Circuit: this represents an auxiliary switch circuit that triggers the system ON for its action. It is one of the main parts of the system where an electronic circuit was designed and built with electronics components incorporated with sound detector sensor (Figure 1) that required little sound through the sensor to trigger ON the pumping machine fixed in the water tank at its pre-set time to flush and rinse the urinal. The main components used were 555 timer, transistor (BC 547), resistors, capacitor and condenser microphone to sense sound for system actions. It required a 6-9 volts battery to power it ON. According to [7], the output voltage of the sound actuated switch circuit can be incorporated with LED indicator and remain turned ON for the time period in seconds using the formula:

$T = 1.1\ xR_1xC_1Seconds$ (Equation 1)

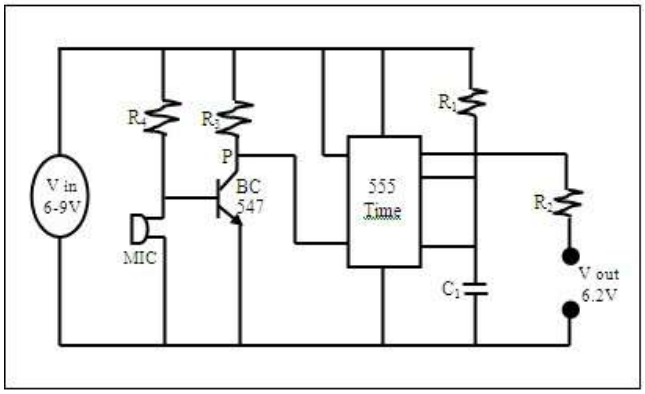

Figure 1: Electronics sound actuated switch circuit

Solar Power System: due to the epileptic power situation in Nigeria, a solar power system was incorporated to ensure uninterrupted power supply for optimum functionality. The solar panel keeps the battery from running below 12 volts as required by the pumping machine. It was incorporated and connected through a solar charge controller to regulate the unregulated DC electricity supply by solar panel and smoothen it to charge the battery. The solar power section was connected to a deep cycle battery, a special purpose and rechargeable battery that restores and replenishes the used power for later use.

Amalgamation of Urinal, Plumbing Materials and Others: the urinal components were amalgamated and connected to serve each other. The urinal, known as a sanitary plumbing fixture for urination only, and for male users only, is usually used in a standing position. It was used in conjunction with an electronic pumping machine and built sound actuated switch circuit to automatically flush the toilet with water without touching or making any contact with the toilet system. The electronics pumping machine moves water by mechanical action, typically converted from electrical energy into hydraulic energy. This was incorporated to convey and pump water from long reach water stored in tanks through the constructed plumbing pipes to the urinal. The electronic pumping machine uses 12 volts DC battery to power ON and is controlled by the built sound actuated circuit as an automated urinal. The plumbing and networking of pipes help to enhance water from long reach water tanks to the urinal pot and also ejects and control the used water out of the toilet urinal.

Casing and packaging: this is the last stage of the construction where mechanical fabrication and technological construction of a suitable casing was made. It was constructed with plastic and wooden materials. This is a prototype to showcase the construction (Figure 2). For efficient use of the system, the construction and built system can be fixed, arranged and amalgamated in houses, public

schools, public offices, public toilets etc.but it is strictly for men only.

III. Results and Discussion

Shown above (Figure 1) is an electronics sound actuated switch circuit that automatically triggers ON and OFF the urinal at a pre-set time. At the initial stage, the transistor in the circuit is OFF and requires only 0.7 volts of base-emitter voltage to turn it ON hence, point P in the circuit is at high potential [7]. This is the point that connects the transistor to trigger PIN 2 of 555 timer IC and as a result pin 2 is also at high potential. Since the 555 timer is required to trigger through trigger PIN 2, the voltage of the PIN 2 must be below VCC/3 of the supply [7]. Therefore, the output voltage is 0 volt and the LED indicator is OFF. Little sounds produced at close range (>10 cm) such as the rubbing of fingers can be sensed by the sound sensor (electric condenser microphone shown at the top right hand corner in Figure 1). The sound signal converted into electrical energy signal and raised the potential at the base of the transistor, which turned ON the transistor [7]. Furthermore, potential at point P becomes low and triggers the 555 timer IC (because of the low voltage below VCC/3 of the supply) at trigger Pin 2 and output voltage or LED indicator turn ON. The output voltage measure was 6.2 volts which is suitable to power ON LED or 6 volts relay. At the output voltage, LED indicator was connected to output PIN 3 of 555 timer IC via R_2 resistor as indicator.

However, after some time the LED indicator turned OFF automatically because the 555 timer IC was used in monostable mode. Mathematically, using the equation 1 above and choosing the suitable value of resistor and capacitor with the formulation, the duration of the built circuit was set to 11 seconds as shown.

$T = 1.1\ x\ 100k\Omega\ x\ 100\mu f$

$T = 1.1\ x\ 100x10^{3} x\ 100x10^{-6}$

$T = 11\ seconds$

Finally, the sound actuated switch circuit was modified by replacing LED with 6 volts relay to serve as a switch and control the electronic pumping machine (using 12 volts DC) and supply water to rinse and flush the toilet urinal at pre-set 11 seconds, which has been discussed in academia as enough time to flush and rinse the toilet urinal pot in a normal situation. Since the function of pumping machine is to move fluids (water) from the underground water or stored tank to the users' end, powered by mechanical action, typically converted from electrical energy into hydraulic energy, an electronic pumping machine was incorporated innovatively to convey and pump water from long reach water stored in tanks through the constructed plumbing pipes to flush and rinse the urinal pot at 11 seconds pre-set time of electronic sound actuated switch circuit. Shown (Figure 2) is the prototype package of the invented, designed and constructed solar powered sound automated male pee toilet system for protection against Covid-19.

Figure 2: Solar powered sound automated male pee toilet system for protection against Covid-19

IV. Conclusion

One of the common things in public offices and large working places such as schools, business organizations, government working environment, firms etc., where people spend about 8 to 10 hours every day is having to share the same toilet, day in, day out. There is a responsibility for a higher level of hygiene in such places. This project "solar powered sound automated male pee toilet system for protection against Covid-19" is a safety improving project. Asides helping to cub the pandemic, this project also discourage road side peeing due to many people avoiding public toilets. Its construction is portable, unique and can easily be installed in public places or organization.

V. Recommendations

One of the basic recommended protective measures approved by regulatory agencies to curtail the spread of Covid-19 is to avoid self-contamination from contaminated surfaces hence, this project. The invention of this work prevents people from self-contamination through contaminated surfaces in the toilet as its use requires only little sound signal to power ON the system at its pre-set time.

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Technology under the supervision of Dr. (Mrs.) Olafimihan C. A.

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