ECE 44X Project Closeout

Group 04

20 second motion triggered countdown timer

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1) Design Impact Statement

2.0 Public Health, Safety, and Welfare Impacts

The purpose of this project is to aid the general public's health by ensuring that the user of this device is following the proper CDC guidelines for washing hands [3] which states that a minimum of 20 seconds must be used for washing one's hands. The project will serve not only the common people in their households but will also be an asset within the sanitation stations of hospitals, restaurants and local businesses where each person can follow the proper standards of hand washing with the aid of this small timer that provides you the exact time needed to wash your hands. Proper hand hygiene will reduce the risk of cross contamination and catching viruses from other people that we need to give more care and urgence towards in this age of COVID.

3.0 Cultural and Social Impacts

The main aim of this project is to increase the effects of the correct time needed to wash your hands which the CDC [7] has stated that it should be around 20 seconds for us to properly rub the soap into the entire surface of our hands and wash them. However it has been reported in The Atlantic that most people do not wash their hands for the correct amount of time in a test where [8] 3749 people observed the average time spent was 6 seconds.This affordable and economical solution will affect the not only the healthcare sector but also the general public such as you and I. With the aid of this timer people will be able to far more effectively increase their hand washing time thus ensuring greater cleanliness.

Following Abrams work about how people wash their hands [1], the spread of germs and the common health of an average person needs to be covered with how good their general hygiene is however for one to be held accountable for their actions, our system will not only be of use to adults but also help the next generation. The timer countdown that initiates with our system will show a visual key that even small children can understand and acknowledge thus allowing them to adjust to the proper protocols on hand washing. As this system develops it will be a key component in helping people to gray and become accustomed by default on the required time and method of hand washing thus bring us one step closer to a cleaner and healthier environment.

4.0 Environmental Impacts

One of the main concerns of this project is the electronic waste that will be produced due to this project. We went for a modular design therefore certain components can be easily reordered and replaced and the general structural integrity and water resistance of the system guarantees a long use cycle. The main waste would be in the form of the AAA batteries that will be used to power on the system. Now depending on the frequency of use the system can run on a pair of AAA batteries for some months however in the end once those batteries are depleted

they must be thrown away and with respect to [4] Oregon Law among other laws, alkaline batteries sold in the state since 1996 cannot contain mercury. As most batteries in this age do not have mercury therefore there is not much in the batteries that can be recycled. Our system due to its efficient power saving mode will reduce the number of times the battery will need to be changed and due to the flexibility of the system being usable with any standard sized AAA batteries, the user can choose to use rechargeable AAA batteries as well which may last a lift time for their use, along with the additional backup power feature if needed we can have the system be powered via USB if it needs to be permanently mounted thus further reducing the electronic waste towards the environment..

5.0 Economic Factors

Our system provides a tool to improve hand washing practices thus improving one's hygiene , this would possibly reduce the risk of one catching a virus thus also reducing the risk of all those medicines and hospital bills. When looking at the system we learn that its aim is to help people effectively wash their hands [2] as the average American washes his or her hands roughly 9 to 11 times per day, if you follow the guidelines [3] to wash your hands with soap for at the very least 20 seconds with soap then this timed hand washing can actually help you save around 6 gallons of water per day if we were to stop the water and use the timer as we applied soap to our hands.

References

[1]   Abrams, L. (2013). Study: 95% of People Don't Wash Their Hands 'Correctly'. Retrieved 21 January 2021, from https://www.theatlantic.com/health/archive/2013/06/study-95-of-people-dont-wash-their-hands-correctly/276720/

[2]   C. Davis, "6 Times You Can Turn Off the Tap to Save Water," *Sustainability*, 05-Sep-2017. [Online]. Available: https://sustainability.ncsu.edu/blog/changeyourstate/6-times-you-should-turn-off-the-tap-to-save-water/#:~:text=Save%20water%20while%20washing%20your,the%20tap%20while%20you%20scrub . [Accessed: 15-Apr-2021].

[3]   "When and How to Wash Your Hands," *Centers for Disease Control and Prevention*, 24-Nov-2020. [Online]. Available: https://www.cdc.gov/handwashing/when-how-handwashing.html [Accessed: 21-Jan-2021].

[4]   "What To Do With Batteries," *Recycling Services | Lane Community College*. [Online]. Available: https://www.lanecc.edu/recycle/what-do-batteries#:~:text=Under%20Oregon%20law%2C%20alkaline%20batteries,in%20older%20generation%20alkaline%20batteries.&text=Lithium%20cells%20aren't%20recyclable,at%20permitted%20hazardous%20waste%20incinerators. [Accessed: 14-Apr-2021].

2) Project Timeline

Internal Timeline:

Item	Due Date	Tasks	Members Involved
FALL 2020			
Introductory Email & Initial Discovery Inquiry	10/08/2020	Reaching out / introducing ourselves to our project partner	Group
Team Protocols and Standards Document	10/15/2020	To plan and process	Group
Engineering Requirement Draft	10/15/2020	Requirements steps to execute the project	Group
Project Executive Summary	10/15/2020	An explained summary of the project	Group
Risk Register	10/22/2020	8 possible risks that can occur	Individual
Block Diagram Draft	11/05/2020	A rough draft of block diagram design	Group
Project Charter	11/12/2020	To revise previous assignments and combine them together	Group
Block Diagram	11/26/2020	Final draft of Block Diagram	Group
Engineering Requirements	11/26/2020	To finalize Engineering requirements	Group
Professional Development Assignment	11/29/2020	To attend 2 meetings that is associated with ECE	Individual

Block Validation	12/03/2020	Complete a block that each person is responsible for	Individual
Research Imp	12/03/2020	It's a critical thinking assignment on how to research and solve challenges	Individual
Technical Demo	12/11/2020	To Create a custom made PCB	Individual
WINTER 2021			
First block Check off	Winter Week#3	To prove that each block meets the standards	Individual
Design reviews	Winter Week#4	Have the opportunity to review your work with other peers	Individual
Requirement lock	Winter Week#5	Entry will be closed and unable to change	Group
Second block Check off	Winter Week#6	Similar to First block check off process	Individual
Final block Check off	Winter Week#9	The same process for the first and second block check offs	Individual
Draft of Project poster	Winter Week#11	To create a project poster for spring team exp	Group
SPRING 2021			
Elevator Speech	Spring week#2	Prepare and record an elevator speech for our project	Individual
Design Impact assessment	Spring week#3	To be able to search both negative and positive impact on the design	Individual
Initial system testing	Spring week#4	To prove at least 3 of the engineering requirements	Group
Final System testing	Spring week#7	To prove that the current system meets all graded engineering requirements	Group

Project Closeout Packet	Spring week#8	A closeout packet include Thank you Letter, Next Step document, Artifacts Repository, and NDA/IP Concerns	Group
Project Showcase	Spring week#8	To create a project showcase page on OSU projects website.	Group

External Timeline:
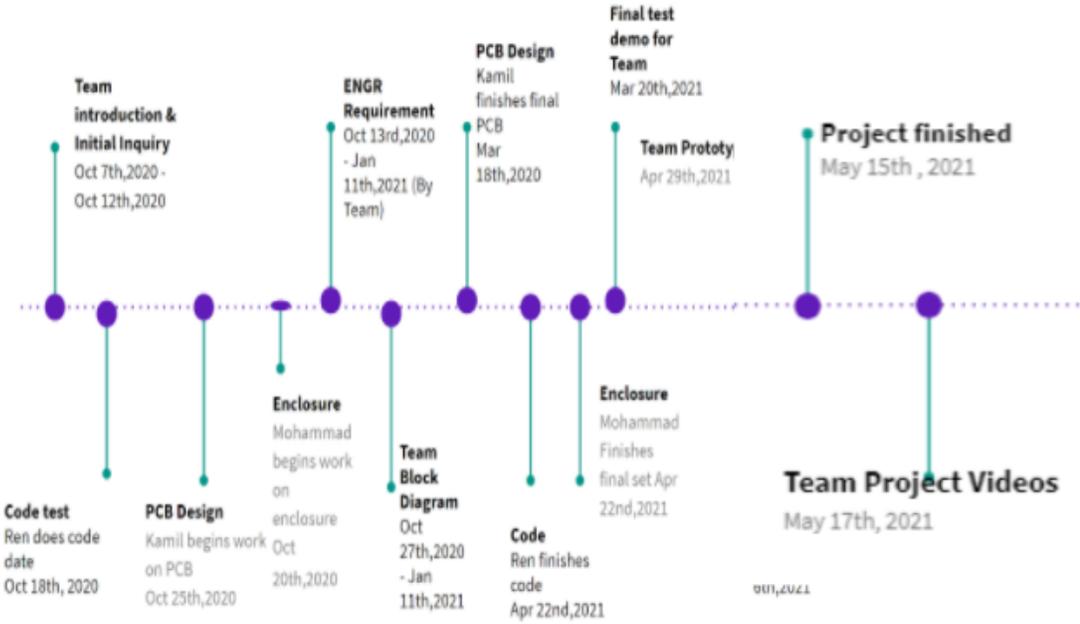
3) Scope and Engineering Requirements Summary

For our 20 second motion triggered timer we will develop a system that at least 9 out of 10 users will be able to use without the need of an instruction manual, To ensure a contactless

activation a motion detection sensor will be used so a user can simply wave their hands across the timer to activate the system.This system will will operate on a rechargeable battery as well as a waterproof build being able to withstand being dropped into a depth of 15cm of water for 10s. To ensure clear readability of time, the countdown will be displayed on an OLED display operating between 5v-8v. The system itself will be contained within a mountable enclosure that will make it accessible to be set up either via double sided tape onto a bathroom mirror or be screwed onto a wall to ensure a secure non-removable mount. To aid the visually impaired the system will output an audio signal to indicate each seconds passing for the 20s countdown. Finally to ensure the systems accessibility and availability to both private and public sectors the system will cost no more than $15 per unit.

Name	Engineering Requirement
01.Ease of Use	At least 9 out of 10 users will use the system without the need of an instruction manual, and will report the system worked intuitively..
02.Motion triggered	The system will detect hand motion for 90 out of 100 users and those users will report that they feel the system detected their hands correctly
03.Battery life	The system must use a 9v battery with a battery life of at least 30 days assuming an activation of 5 minutes per day.
04.Water proof	The system will operate after having 16oz of water dribbled over each cardinal direction, except the back.
05.Digital Display	The system must display the remaining number of seconds reported to be visible by 9 out of 10 users from 4ft away.
06.Mounting	The system will mount to both a mirror with 2.5 lbs weight hanging and a wall and when mounted, hold at least 5lbs of weight hanging from the unit for 30 seconds.
07.Budget	The system total cost needs to be less than or equal to $15, when producing 1000 units including, PCB assembly, mechanical elements, and electrical components.
08.Audio	90 out of 100 users will report they "knew when the timer started and when it was over."

4) Risk Register

Risk ID	Risk Description	Risk category	Risk probability	Risk impact	Performance indicator	Responsible party	Action Plan
R1	Incompatible interface	Technical	40%	M	Components are wrong	Ren	Reduce
R2	Vendor delay	Timeline	80%	H	Expected shipment	Kamil	Retain
R3	Over Budget	Cost	25%	L	Price change	Mohammed	Reduce
R4	Team member absence	timeline	40%	H	Student Attendance	Kamil	Transfer
R5	Environmental disaster	timeline	15%	H	Public News/Media	Kamil	Transfer
R6	Battery damaged	cost/Timeline/Technical	35%	M	Does not power on	Mohammed	Reduce
R7	System Overheating	Technical	10%	H	High running temperature	Kamil	Reduce
R8	Short circuit	Technical	20%	H	System does not function	Ren	Reduce

5) Future Recommendations

1) <u>Improve system ease of use</u>
Currently the system is easy to use and intuitive based on a in-person test (with respect to COVID restrictions) in which we tested the usability of the system with only 10 users and got a 90% success rate. We did not take into account having this system being used by people with disabilities.
Recommendation: When doing the design we should plan to have some visual instructions for some users who feel it will be a lot easier to use the device even though we aim to make the system as intuitive as possible this will be good guidance. This will ease up for all targets and have all users to be satisfied and possibly aim for a wider audience by doing demos with 100 or more users from different types.Hopefully having a more easily accessible form of starting the device with people who might have issues in raising their hands to reach the system.

2) Make motion trigger sequence more efficient
Currently the system will detect at least 90 out of 100 users correctly giving us a 90% success rate with the PIR sensor that we used but this system was tested in controlled environments in individual hand washing attempts..
Recommendation: When doing the design, find a better alternative motion sensor with the ability to adjust the sensitivity for a higher performance.Something with a variable adjustable range to change its accuracy and distance for detecting a person depending on their height , age and state of mind.

3) Increase the System battery life to 60 days
Currently the system battery life is approximately 30 days with the activation of 5 minutes per day which we were able to test out assuming that the average person washes their hands between 1-15 times a day.
Recommendation: When doing the design we will aim for a battery life of 60 days or more with the same average of 5 minutes so that it lasts longer for our users.

4) Make system completely submersible in water
Currently the system will operate after having 16oz of water dribbled over each cardinal direction, except the back.But it is not fully waterproof
Recommendation: When doing the design, consider the size of the inside circuit and all parts of the device. Find a good way to avoid water into the enclosure. Make sure the total system could submerge into the water for 5 mins and still function, giving it a valid IP rating.

5) Improve readability of Digital display
Currently the system's countdown on the OLED is visible from 4 ft away when looking at the system straight.
Recommendation: When doing the design a digital display will play a vital role in making users more satisfied knowing the time spent to wash their hands. A small 0.96 inch display might not be good enough to be seen so we should plan to have alternative ways to have the time to be reported nicely especially for elderly and children possibly integrate a game like animation for children .Plan to have it longer than 4ft away so about 10ft for better ease of readability so others waiting in line to wash their hands can see how much time is left as well.

6) Strengthen Mounting
Currently the system can withstand 2.5 lb in weight if by tape and 5lb in weight if it was screw mounted for at least 30 sec where we took into account slight taps on the enclosure
Recommendation: When doing the design we need to make it more stable by increasing the weight from 2.5 lb to 5 lb if installed by tape and from 5lb to 10lb if it was screw mounted to increase its stability and in case it was accidently hit by the user or possibly a child trying to play with it.

7) Decrease cost of production
Currently the system would cost about $15 per unit. This was done after great effort in ensuring a group of engineering students could produce a functioning system for this price range.

Recommendation: When doing the design In order to reduce the budget, we need to come up with a plan that will work perfectly. We will have to change some elements that can be replaced to something with the same efficient but different brands. We will try to keep the budget within $10 per unit or lower to make this system an affordable choice for all to use..

8) <u>Improve Audio quality and features</u>
Currently the system can assure that at least 90 out of 100 users knew when the timer started and ended giving us a 90% success rate however this was done in individual tests.
Recommendation: When doing the design we need to make sure the audio can assure users know the timer started and ended clearly like using voice "start" and "end" instead of the beep sound and increase the volume of the sounds something that people understand more clearly especially if they are in a location with more noise.