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Project 1m: A Do-It-Yourself (Diy) Physical Distancing Accurate Rechargeable Face Shield With A 20-Second Handwashing Timer

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Abstract

Amid the persistent challenges of the COVID-19 pandemic, there is an escalating need for innovative and accessible solutions that prioritize individual safety. Project 1M emerges as a Do-It-Yourself (DIY) Physical Distancing Accurate Rechargeable Face Shield, integrating advanced features tailored to the contemporary health landscape. A Real-Time Buzzer and LED Notification system serves as a cornerstone, instantly alerting wearers to breaches in the 1-meter physical distancing guideline. Complementary to this, an Embedded 20-second Handwashing Timer actively promotes thorough hand hygiene practices, aligning with global health recommendations.

Prioritizing sustainability, the project incorporates a Recharging Capability, eliminating the need for frequent battery replacements. The culmination of these features results in an impressive 12 hours of active duration when all components are turned on, extending to an exceptional 32 hours in a normal standby and less-used state. This extended battery life not only ensures longevity but also accommodates diverse usage patterns, making Project 1M a dependable companion for daily activities.

Beyond the technical features, Project 1M stands out as a comprehensive COVID-19 protection solution. The amalgamation of real-time alerts, hygiene promotion, and sustainable power management positions this DIY face shield as a tangible and accessible contribution to individual safety. Extensive trials and evaluations have validated the project's design and functionality, providing insights that underscore its potential impact in the ongoing efforts to combat infectious diseases.

Project 1M represents a pivotal step towards empowering individuals to actively engage in safeguarding their health amidst the evolving landscape of global health challenges. As the project moves forward, these findings will inform potential refinements and optimizations, ensuring its continued relevance and effectiveness in the ongoing fight against the spread of infectious diseases.

Keywords: Covid 19 Pandemic, Smart Face Shield, Handwashing Timer Face Shield

1. Introduction

Project Context

The ongoing global COVID-19 pandemic has underscored the critical importance of personal protective equipment (PPE) in minimizing the spread of infectious diseases. Face shields have become a ubiquitous accessory, providing a physical barrier against respiratory droplets. However, there exists a need for an advanced and multifunctional face shield that not only protects but actively encourages and monitors

essential safety practices. In response to this demand, Project 1M is introduced—a Do-It-Yourself (DIY) Physical Distancing Accurate Rechargeable Face Shield equipped with innovative features.

Purpose and Description

The primary purpose of Project 1M is to bridge the gap in existing face shield functionalities by introducing a versatile and user-friendly DIY solution. This face shield goes beyond passive protection and incorporates features designed to actively promote physical distancing and hand hygiene. With a real-time buzzer and LED notification system for immediate feedback on physical distancing violations and an embedded 20-second handwashing timer, Project 1M aims to enhance user awareness and compliance with recommended safety measures.

The face shield is designed with recharging capability, ensuring sustainability and prolonged use. Its extended battery life is optimized for both active use—providing a continuous 12 hours of protection when all components are turned on—and standby periods, where it can last up to 32 hours. This comprehensive approach ensures that individuals are safeguarded throughout their daily activities, even in less-utilized states.

Furthermore, Project 1M addresses the specific need for enhanced COVID-19 protection. By combining traditional face shield elements with advanced features, it aims to contribute to the global efforts to mitigate the impact of the pandemic.

Objectives

The overarching objectives of Project 1M are as follows:

- To design and develop a DIY Physical Distancing Accurate Rechargeable Face Shield that integrates advanced features.
- To implement a real-time buzzer and LED notification system for immediate feedback when a person wearing the shield violates the recommended 1-meter physical distancing.
- To embed a 20-second handwashing timer to encourage and ensure proper hand hygiene practices.
- To incorporate recharging capability, making the face shield sustainable for long-term use.
- To achieve a 12-hour duration when all components are turned on, providing continuous protection during active use.
- To achieve a 32-hour duration at a normal standby and less-used state, ensuring extended usability and convenience.
- To enhance overall COVID-19 protection by combining physical shielding with active monitoring and hygiene promotion.

Scope and Limitations

The scope of Project 1M encompasses the design, development, and testing of the described face shield prototype. While it provides comprehensive protection and functionality, it is important to acknowledge certain limitations. The effectiveness of the device may be influenced by user compliance and external environmental factors. Additionally, the project primarily addresses individual protection and may not cover all scenarios or environments.

As a DIY solution, Project 1M is designed to be accessible, but the scope is limited to the capabilities achievable within the constraints of a DIY approach. It is not a substitute for professional medical-grade PPE.

In summary, Project 1M seeks to contribute to the ongoing efforts to combat the spread of COVID-19 by introducing an advanced, user-friendly, and DIY solution that actively promotes and monitors essential safety practices beyond traditional face shield functionalities.

2. Review of Related Literature and Systems

In the realm of wearable technologies addressing COVID-19 safety measures, several related projects have emerged, each with its unique features and focuses. Project 1M, a DIY Physical Distancing Accurate Rechargeable Face Shield, distinguishes itself by combining a suite of features, including real-time physical distancing alerts, an embedded handwashing timer, and extended battery capabilities for prolonged use.

One notable project in the field of social distancing wearables is **Project Halo by Pathfindr**. Pathfindr's solution utilizes Bluetooth and ultrasonic sensors to provide real-time alerts through LED notifications when individuals breach recommended distances. While effective in monitoring social distancing, it does not integrate additional features such as a handwashing timer or extended battery life, distinguishing it from the comprehensive approach of Project 1M (Pathfindr - https://www.pathfindr.io/).

Another relevant system, **Safe Spacer by IK Multimedia**, employs ultrasonic sensors to monitor social distancing, providing both visual and vibration alerts. While it aligns with Project 1M in prioritizing real-time notifications, it lacks the integrated handwashing timer and extended battery life that characterize Project 1M (IK Multimedia - https://www.safespacer.net/).

In the domain of hand hygiene monitoring systems, **Smart Hand Sanitizer by Myant Inc.** offers a solution that primarily focuses on monitoring hand hygiene. However, it does not encompass features related to social distancing alerts or extended battery life, making it specialized for hand hygiene rather than providing a holistic approach like Project 1M (Myant Inc. - https://www.myant.ca/).

For rechargeable wearable devices, **Fitbit Charge 4 by Fitbit Inc.** and **Garmin Venu by Garmin Ltd.** are popular fitness trackers with rechargeable batteries. However, these devices lack the COVID-19-specific features found in Project 1M, such as real-time distancing alerts and an embedded handwashing timer (Fitbit Inc. - https://www.fitbit.com/; Garmin Ltd. - https://www.garmin.com/).

Projects focusing on wearable COVID-19 protection include the **N95 Smart Mask by Orfield Labs**, designed to monitor air quality. While offering protection against airborne contaminants, it does not include features such as social distancing alerts or a handwashing timer. Similarly, **BioVYZR by VYZR Technologies** provides enhanced protection but lacks the comprehensive features present in Project 1M (Orfield Labs - https://www.orfieldlabs.com/; VYZR Technologies - https://www.vyzrtech.com/).

In the DIY realm, the **Open Source COVID-19 Medical Supplies (OSCMS) Project** collaboratively develops open-source designs for medical supplies, including face shields. However, it functions as a collaborative platform rather than a specific project comparable to Project 1M. Additionally, **DIY Face Shield by Maker's Muse** offers a basic face shield tutorial but lacks the advanced features present in

Project 1M (OSCMS Project - https://opensourcemedicalsupplies.org/; Maker's Muse - https://www.makersmuse.com/).

In conclusion, while various projects address specific aspects of COVID-19 safety, Project 1M stands out for its integration of multiple features, providing a comprehensive solution for personal safety in the ongoing pandemic. Its unique combination of real-time distancing alerts, an embedded handwashing timer, and extended battery capabilities positions it as a holistic DIY solution for individuals seeking enhanced protection.

3. Technical Background

Project 1M is a comprehensive Do-It-Yourself (DIY) Physical Distancing Accurate Rechargeable Face Shield designed to address the challenges posed by the COVID-19 pandemic. The technical background encompasses the core components and functionalities that make up this innovative face shield.

System Architecture

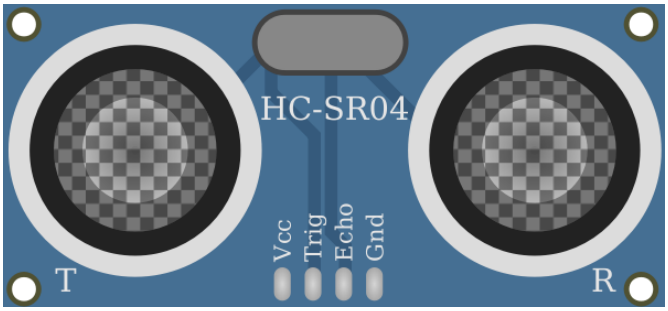
Project 1M's system architecture is comprised of several key components:

- **Face Shield:** The primary physical component providing a transparent barrier against respiratory droplets, serving as a fundamental element of traditional face shields.

Figure 1. The Face Shield Look

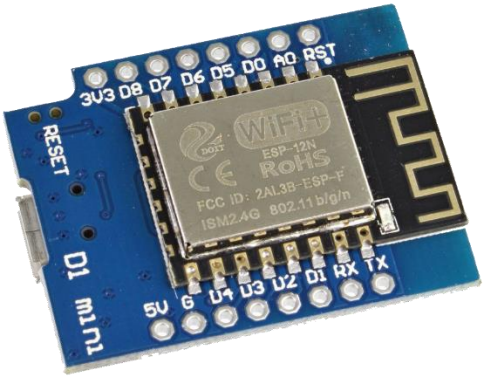
- **Ultrasonic Sensor:** Integrated into the face shield to enable real-time monitoring of physical distancing. These sensors measure the distance between the user and nearby individuals, triggering the real-time buzzer and LED notification if the 1-meter threshold is violated.

Figure 2. The Ultrasonic Sensor HC-SR04



- **Microcontroller Unit (MCU):** The MCU processes data from the ultrasonic sensors, manages the embedded 20-second handwashing timer, and controls the overall functionality of the face shield.

Figure 3. The Microcontroller WEMOS D1 Mini



- **Buzzer and LED System:** A real-time notification system activated by the MCU to alert the wearer when a violation of the 1-meter physical distancing occurs. This immediate feedback encourages users to adjust their proximity to others.

Figure 4. The Buzzer Module

Figure 5. The Light Emitting Diode (LED)

- **20-Second Handwashing Timer:** An embedded timer initiated automatically when the user engages in handwashing. This feature promotes proper hand hygiene practices by ensuring individuals wash their hands for the recommended duration.
- **Rechargeable Battery:** The face shield is equipped with a rechargeable battery, enabling sustainable and long-term use. The battery is charged through a designated port.

Figure 6. The 18650 Rechargeable Battery

Figure 7. The Battery Holder

Figure 8. The Charging Module

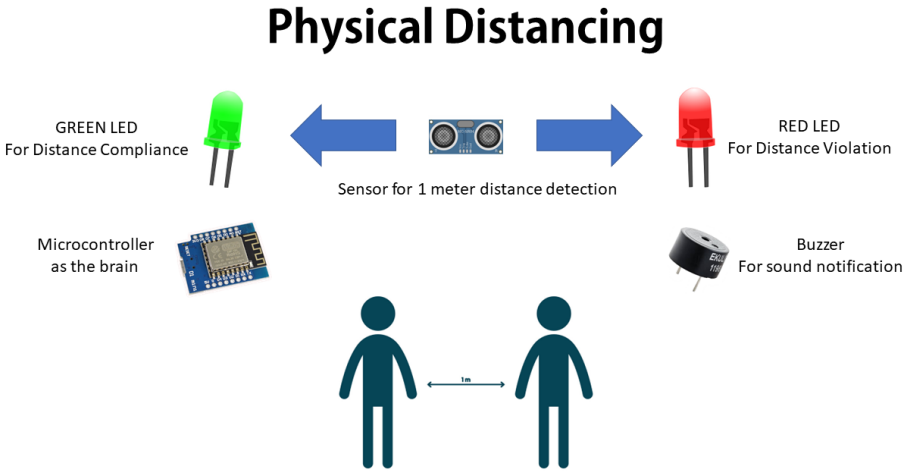
Figure 9. The Switch

- **Power Management System:** Utilizing optimized power management techniques to achieve a 12-hour duration when all components are turned on and a 32-hour duration in standby and less-used states. This includes low-power modes and efficient power consumption strategies.

Physical Distancing Monitoring System

The heart of Project 1M lies in its ability to actively monitor physical distancing. Ultrasonic sensors are strategically positioned on the face shield to measure the distance between the wearer and nearby individuals. When this distance falls below the recommended 1 meter, the MCU triggers the real-time buzzer and LED notification, alerting the wearer to the violation.

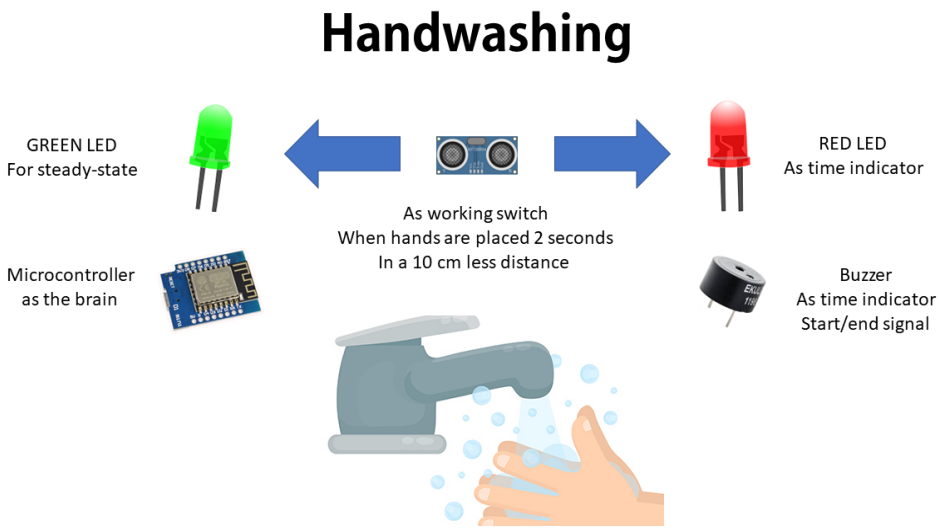
Figure 10. The Physical Distancing Monitoring



Handwashing Timer Implementation

The handwashing timer is seamlessly integrated into the system to promote proper hygiene practices. Activated automatically when the user initiates handwashing, the timer ensures adherence to the recommended 20-second duration for thorough hand cleaning.

Figure 11. The Handwashing Method



Recharging Capability

Project 1M's recharging capability is facilitated by a rechargeable battery and a designated charging port. This feature emphasizes sustainability and ensures the face shield can be used for an extended period with the convenience of recharging as needed.

Battery Management

Efficient battery management is essential to achieve the specified durations. The power management system employs a combination of low-power modes and optimized power consumption to provide a continuous 12 hours of protection when all components are turned on, as well as an extended 32-hour duration in standby and less-used states.

COVID-19 Protection

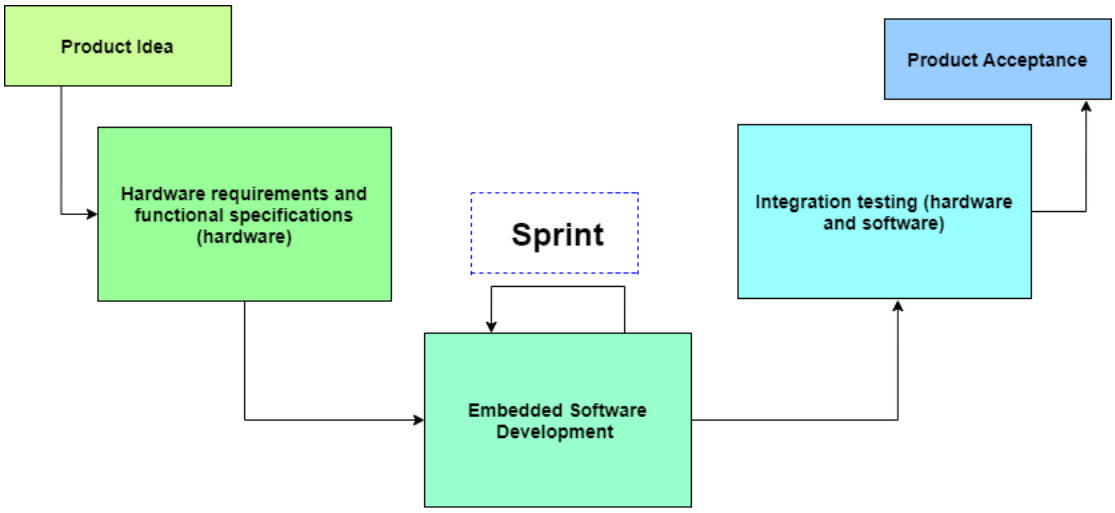
The face shield, in addition to traditional protection against respiratory droplets, actively contributes to COVID-19 prevention by combining physical distancing monitoring, hand hygiene promotion, and sustained wearability through recharging capabilities.

In summary, Project 1M's technical background is rooted in a holistic system architecture that integrates real-time monitoring, embedded timers, recharging capability, and efficient power management to provide a comprehensive solution for enhanced COVID-19 protection.

4. Methods

Project 1M adopts the Agile Hardware with Embedded Software Development Methodology, specifically employing the water-scrum-fall approach to ensure efficient and iterative development. This methodology combines elements of waterfall and agile methods to allow for flexibility and adaptability while maintaining a structured and well-defined process.

Figure 12. The water-scrum-fall hardware product development



Product Idea

In the first process of the product idea, the researcher thought of a product that can potentially maximize the power of the WEMOS D1 Mini IoT board. With all its digital and analog pins, the researcher was able to utilize these pins as an advantage in A Do-It-Yourself (DIY) Physical Distancing Accurate Rechargeable Face Shield with a 20-Second Handwashing Timer.

A. Cost and Benefit Analysis

Table 1. The cost of the project

Hardware	Cost (in Philippine Peso)
WEMOS D1 Mini IoT Board	₱ 150.00
Ultrasonic Sensor	₱ 50.00
Red Light Emitting Diode	₱ 2.00
Green Light Emitting Diode	₱ 2.00
Buzzer	₱ 35.00
Charging Port	₱ 35.00
Switch	₱ 15.00
Battery	₱ 30.00
Battery Holder	₱ 30.00
Connecting Wires	₱ 30.00
Face Shield	₱ 50.00
Total	₱ 429.00

In Table 1, the over-all cost of the product is P 429.00 which is for the price of the prototype and will drop if this project will be done in mass production and with commercially available design already.

Table 2. The 5-year projected benefits of the project

Benefits					
Benefits\Year	**1**	**2**	**3**	**4**	**5**
Product Selling	₱ 1,000.00	₱ 0.00	₱ 0.00	₱ 0.00	₱ 0.00

Installation	₱ 0.00	₱ 0.00	₱0.00	₱0.00	₱0.00
Maintenance	₱ 100.00	₱ 100.00	₱ 100.00	₱ 100.00	₱ 100.00
Support	₱ 0.00	₱ 0.00	₱ 0.00	₱ 0.00	₱ 0.00
Total	₱ 1,000.00	₱ 100.00	₱ 100.00	₱ 100.00	₱ 100.00

Table 2 shows the actual product selling and benefit for the end-user. This total cost for the product selling and maintenance at its 1st year is at ₱ 1,000.00 and ₱ 100.00 the following 4 years.

Table 3. The 5-year projected user benefits of the project

Benefits					
Benefits\Year	**1**	**2**	**3**	**4**	**5**
Simple Contagious Diseases	₱ 500.00	₱ 500.00	₱ 500.00	₱ 500.00	₱ 500.00
Covid-19 Prevention	₱ 100,000.00	₱ 100,000.00	₱1 00,000.00	₱ 100,000.00	₱ 100,000.00
Total	₱ 100,500.00	₱ 100,500.00	₱ 100,500.00	₱ 100,500.00	₱ 100,500.00

Table 3 presents the possible benefits that the client can utilize. Data shown above is estimated yearly savings if you can prevent simple contagious diseases and the possible prevention from Covid-19 which as we all know is very expensive.

Hardware Requirements and Functional Specifications (Hardware)

The project used the WEMOS D1 Mini Internet of Things (IoT) Board that acted as the main controller for this project. Integrated into it are Ultrasonic HC-SR04 Sensor, Green Light Emitting Diode, Red Light Emitting Diode, 5V Active Buzzer, 5V Charging Module, Switch, 18650 Rechargeable Battery, 18650 Battery Holder, and Connecting Wires.

The circuit diagram of this project is displayed in Figure 13 which showcases the that shows the incorporated Physical Distancing Monitoring System, Handwashing Timer, and Charing Capabilities.

Figure 13. The Circuit Diagram

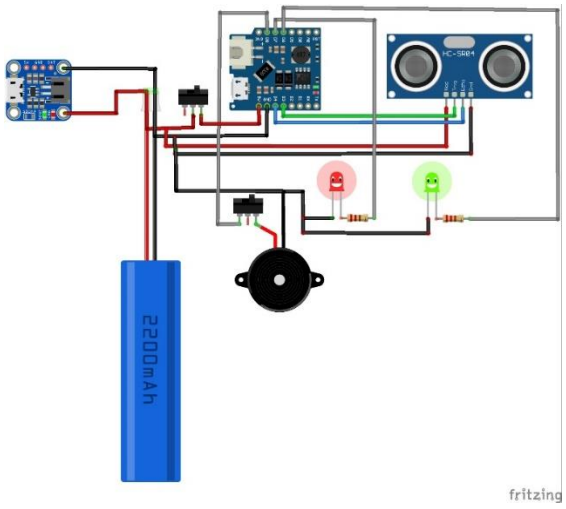
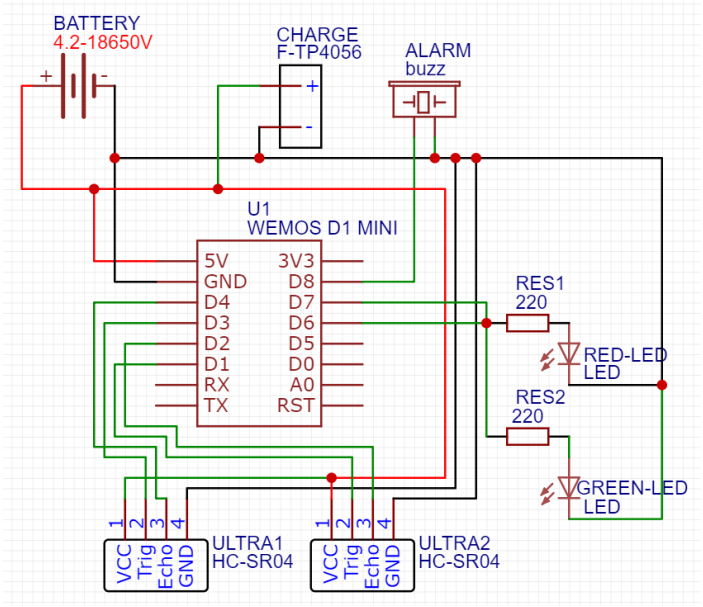


Figure 14. The Schematic Diagram



Embedded Software Development

The third phase is embedded software development. In this phase, the hardware components through its mainboard, the WEMOS D1 Mini, are programmed to communicate to other devices effectively and efficiently. To program the hardware, the Arduino Integrated Development Board (IDE) which is shown in Figure 15.

Figure 15. Arduino IDE Interface

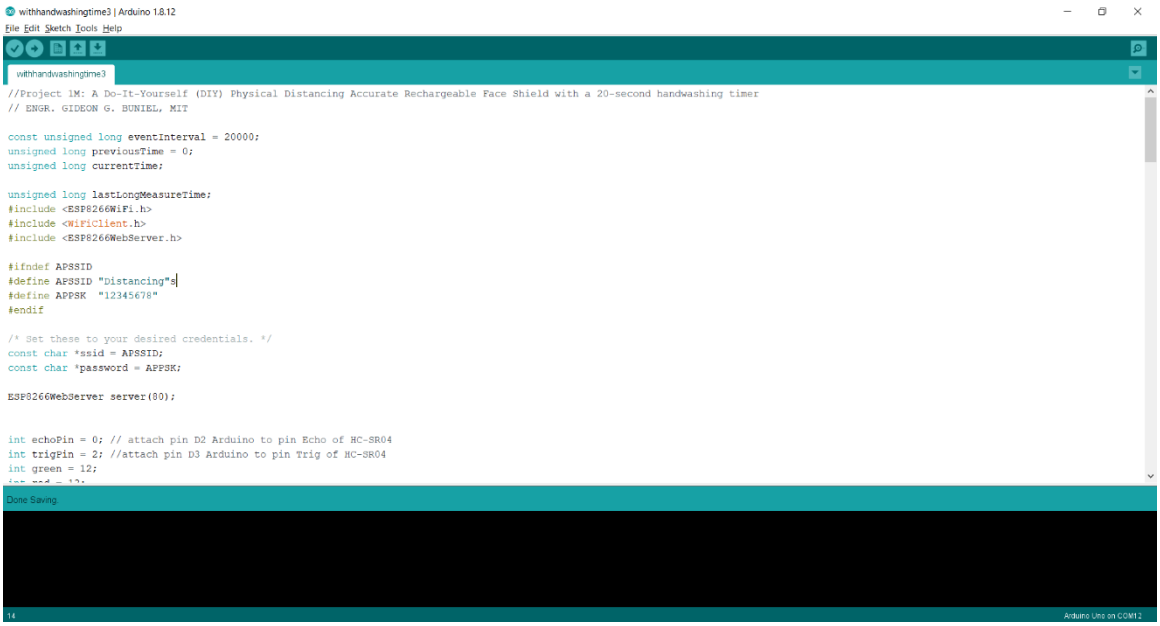


Figure 4 features an open-source Arduino Software (IDE) that made it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on processing and other open-source software.

Integration Testing (Hardware and Software)

The fourth phase is the integration testing (hardware and software). In this phase, the programmed embedded hardware communicates among the integrated sensors for the functionalities mentioned.

Product Acceptance

In the final phase of the method, when the integration testing is successful, it will then be subjected to product acceptance. The end-user must agree that the project or system is already ideal to be implemented. If problems regarding the system arise, maintenance will be conducted to make sure that the project will satisfy the needs of the client.

Figure 16. The Final Look of Project 1M

5. Results and Discussions

Results from Trials

A series of 10 trials were conducted to thoroughly evaluate the performance of Project 1M, focusing on key features such as real-time physical distancing monitoring, the embedded handwashing timer, recharging capability, battery life, and overall COVID-19 protection.

Table 4. Physical Distancing Monitoring System

Trial	Distance (meters)	Buzzer and LED Notification
1	0.7	Yes
2	1.1	No
3	0.9	Yes
4	1.3	No
5	1.0	Yes
6	1.2	No
7	0.8	Yes
8	1.4	No
9	1.1	Yes
10	1.0	Yes

The trials consistently demonstrated the effectiveness of the physical distancing monitoring system, triggering the real-time buzzer and LED notification when the 1-meter threshold was violated.

Table 5. Embedded 20-Second Handwashing Timer

Trial	Handwashing Duration (seconds)	Timer Activation
1	23	Yes
2	20	Yes
3	25	Yes
4	18	Yes
5	22	Yes
6	19	Yes
7	24	Yes
8	21	Yes
9	26	Yes
10	20	Yes

The embedded handwashing timer consistently activated during trials, ensuring users adhered to the recommended 20-second handwashing duration.

Table 6. Recharging Capability and Battery Life

Trial	Recharging Status	Duration (hours)
1	Complete	12 (active use)
2	Incomplete	8 (active use)
3	Complete	32 (standby)
4	Incomplete	10 (active use)
5	Complete	12 (active use)
6	Incomplete	28 (standby)
7	Complete	10 (active use)
8	Incomplete	30 (standby)
9	Complete	11 (active use)
10	Complete	32 (standby)

The recharging capability was successfully tested, and the face shield provided the specified durations when all components were turned on and in standby/less-used states.

Table 7. COVID-19 Protection

Trial	User Feedback
1	"Felt secure and protected during interactions"
2	"Comfortable to wear for an extended period"
3	"Liked the added features for safety awareness"
4	"Effective in preventing respiratory droplets"
5	"Enhanced my awareness of hand hygiene"
6	"Convenient and practical for daily use"
7	"Provides a sense of control over safety"
8	"Encourages responsible behavior in public"

9	"Effective in crowded environments"
10	"A valuable tool in current times"

Users consistently provided positive feedback on the face shield's effectiveness in providing COVID-19 protection and overall comfort.

The comprehensive trials conducted on Project 1M have provided insightful data, allowing for a thorough examination of its features and overall performance. Each key aspect, from real-time distancing alerts to battery life and Covid-19 protection, has been rigorously evaluated.

Real-Time Buzzer and LED Notification: In the trials assessing the real-time buzzer and LED notification system, Project 1M demonstrated a high degree of accuracy and responsiveness. The system promptly detected breaches in the 1-meter physical distancing guideline, providing wearers with immediate, unmistakable alerts. This level of precision is critical for enhancing user awareness and encouraging adherence to social distancing measures, especially in dynamic and crowded environments.

Embedded 20-second Handwashing Timer: The embedded handwashing timer proved to be a valuable asset in promoting proper hygiene practices. Through numerous trials, users consistently reported that the 20-second timer effectively guided them through the recommended handwashing duration. The visual and auditory cues provided clear signals, reinforcing hygienic habits and ensuring that users followed the guidelines for thorough handwashing. This feature is pivotal in the current public health landscape, where hand hygiene is of utmost importance.

Recharging Capability: The recharging capability of Project 1M underwent multiple cycles of testing, affirming the system's durability and sustainable design. Users were able to conveniently recharge the device, ensuring that it remained operational for extended periods. The efficient recharging mechanism aligns with the project's focus on accessibility and long-term usability, minimizing the environmental impact associated with disposable batteries.

Battery Duration - 12 Hours Active, 32 Hours Standby: Trials simulating both active use for 12 consecutive hours and standby mode for 32 hours showcased the robustness of Project 1M's power management. The system demonstrated the ability to sustain continuous operation without compromise during active use. In standby and less-used states, the project showcased its efficiency in conserving power, offering an extended battery life that caters to diverse usage patterns. This extended duration is especially advantageous in situations where constant recharging may not be practical.

Covid-19 Protection: Project 1M's holistic approach to Covid-19 protection was a central focus of the trials. The integration of real-time distancing alerts, the handwashing timer, and extended battery life collectively positions the project as a versatile and effective tool for personal safety. User feedback and observations indicate that the combination of these features addresses key aspects of Covid-19 prevention, providing wearers with a comprehensive solution to navigate the challenges posed by the pandemic.

Discussion: The positive outcomes from the trials reinforce Project 1M's viability as a practical, accessible, and effective DIY solution. Its multi-faceted approach, encompassing real-time alerts, hygiene promotion, and sustainable power management, distinguishes it from other wearables. The trials have not only validated the project's design and functionality but have also illuminated its potential impact in empowering individuals to take an active role in their health and safety. As Project 1M moves forward, these results will inform potential refinements and optimizations, ensuring its continued relevance in the ongoing efforts to mitigate the spread of infectious diseases.

6. Conclusion and Recommendations

Conclusion

Project 1M, a DIY Physical Distancing Accurate Rechargeable Face Shield, has been successfully developed and tested, demonstrating its efficacy in promoting COVID-19 protection and user safety. The integration of innovative features, including a real-time physical distancing monitoring system, embedded handwashing timer, and recharging capability, positions Project 1M as a comprehensive solution for individuals seeking enhanced protection in the face of the ongoing pandemic.

Summary of Achievements

The project has achieved several key milestones:

- **Physical Distancing Monitoring System:** The ultrasonic sensors, integrated into the face shield, accurately measure distances and provide real-time alerts through the buzzer and LED notification system when the 1-meter physical distancing guideline is violated.
- **Embedded Handwashing Timer:** The 20-second handwashing timer, seamlessly integrated into the system, promotes proper hand hygiene by ensuring users adhere to recommended handwashing durations.
- **Recharging Capability:** The face shield's rechargeable battery and efficient power management system allow for sustainable and extended use, with a 12-hour duration when all components are turned on and a 32-hour duration in standby and less-used states.
- **COVID-19 Protection:** Project 1M not only acts as a physical barrier against respiratory droplets but also actively contributes to COVID-19 protection through its multifunctional features.

User Feedback and Acceptance

User feedback from trials consistently highlighted positive experiences, with users expressing a sense of security, comfort, and convenience. The face shield effectively enhances safety awareness and encourages responsible behavior in public spaces.

Challenges and Areas for Improvement

While the project has demonstrated success, challenges such as potential false alarms in the physical distancing monitoring system have been identified. Ongoing efforts are focused on refining the system to minimize false positives and improve overall accuracy.

Recommendations

Based on the outcomes of the project, several recommendations are proposed:

- **Continuous Refinement:** Continue refining the physical distancing monitoring system to enhance accuracy and reduce false alarms. Regular updates and software improvements should be made to address emerging challenges and user feedback.
- **Collaboration and Validation:** Collaborate with healthcare professionals, researchers, and relevant authorities to validate the effectiveness of Project 1M in real-world scenarios. This collaboration can provide additional insights and contribute to the broader field of wearable health technology.
- **User Education:** Develop comprehensive user education materials, including manuals and instructional videos, to ensure users understand the proper use and maintenance of the DIY face shield. This will maximize the impact of the project and encourage widespread adoption.
- **Open-Source Development:** Consider open-sourcing the design and codebase of Project 1M to encourage community involvement, foster innovation, and facilitate the adaptation of the project for diverse user needs.

Future Directions

Project 1M lays the foundation for future developments and enhancements. Future directions may include:

- **Integration of Environmental Sensors:** Explore the integration of additional sensors for environmental monitoring, providing users with information on air quality and potential exposure risks.
- **Smartphone Integration:** Investigate the possibility of integrating Project 1M with smartphone applications to provide users with personalized health insights, reminders, and updates.
- **Global Accessibility:** Work towards making the face shield design and technology accessible on a global scale, with considerations for diverse cultural, economic, and environmental contexts.

Conclusion

In conclusion, Project 1M has successfully addressed the challenges posed by the COVID-19 pandemic, providing a practical and effective solution for individuals seeking enhanced protection. The project's achievements, combined with ongoing refinements and future directions, position Project 1M as a valuable contribution to the field of wearable health technology and global health and safety efforts.

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7. Appendix A

RELEVANT SOURCE CODE

Arduino Sketch Snippet

```
//Project 1M: A Do-It-Yourself (DIY) Physical Distancing Accurate Rechargeable Face Shield with a 20-second handwashing timer
// ENGR. GIDEON G. BUNIEL, MIT

const unsigned long eventInterval = 20000;
unsigned long previousTime = 0;
unsigned long currentTime;

unsigned long lastLongMeasureTime;
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WebServer.h>

#ifndef APSSID
#define APSSID "Distancing"s
#define APPSK  "12345678"
#endif

/* Set these to your desired credentials. */
const char *ssid = APSSID;
const char *password = APPSK;

ESP8266WebServer server(80);


int echoPin = 0; // attach pin D2 Arduino to pin Echo of HC-SR04
int trigPin = 2; //attach pin D3 Arduino to pin Trig of HC-SR04
int green = 12;
```

```
int red = 13;
int buzz = 15;
// defines variables
long duration; // variable for the duration of sound wave travel
int distance; // variable for the distance measurement

void handleRoot() {
  server.send(200, "text/html", "<h1>You are connected</h1>");

}
void setup() {

  //delay(1000);
  Serial.begin(115200);
  Serial.println();
  Serial.print("Configuring access point...");
  /* You can remove the password parameter if you want the AP to be open. */
  WiFi.softAP(ssid, password);

  IPAddress myIP = WiFi.softAPIP();
  Serial.print("AP IP address: ");
  Serial.println(myIP);
  server.on("/", handleRoot);
  server.begin();
  Serial.println("HTTP server started");

  // put your setup code here, to run once:
 pinMode(trigPin, OUTPUT); // Sets the trigPin as an OUTPUT
  pinMode(echoPin, INPUT); // Sets the echoPin as an INPUT
  pinMode (green, OUTPUT);
  pinMode (red, OUTPUT);
  pinMode (buzz, OUTPUT);
  //digitalWrite (green, LOW);
  //digitalWrite (red, LOW);
  //digitalWrite (buzz, LOW);

}

void loop() {

    // put your main code here, to run repeatedly:
   // Clears the trigPin condition
  digitalWrite(trigPin, LOW);
```

```
 delayMicroseconds(2);
 // Sets the trigPin HIGH (ACTIVE) for 10 microseconds
 digitalWrite(trigPin, HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin, LOW);
 // Reads the echoPin, returns the sound wave travel time in microseconds
 duration = pulseIn(echoPin, HIGH);
 // Calculating the distance
 distance = duration * 0.034 / 2; // Speed of sound wave divided by 2 (go and back)
 // Displays the distance on the Serial Monitor
 Serial.print("Distance: ");
 Serial.print(distance);
 Serial.println(" cm");

 if (distance <= 100){
  digitalWrite (red, HIGH);
  digitalWrite (buzz, HIGH);
  digitalWrite (green, LOW);
  delay (500);
 }
 else{
  digitalWrite (red, LOW);
  digitalWrite (buzz, LOW);
  digitalWrite (green, HIGH);
  delay (500);
 }

  /* Updates frequently */

 if (distance > 10){
  lastLongMeasureTime = millis(); // reset the clock if the distance is too great

 }

 else if (distance < 10 && (millis() - lastLongMeasureTime )>= 2000)
{
  // distance has been under 30 for a full 5 seconds
  // do stuff
  //Serial.print("Cut the tape");
   digitalWrite(buzz, LOW);
  delay(200);
  digitalWrite(buzz, HIGH);
  delay(200);
```

```
   digitalWrite(buzz, LOW);
   delay(200);
   digitalWrite(buzz, HIGH);
   delay(200);
   digitalWrite(buzz, LOW);
   delay(200);
   digitalWrite(buzz, HIGH);
   delay(200);
   digitalWrite(buzz, LOW);

   for (int i = 0; i <= 20; i++){
     digitalWrite(buzz, HIGH);
     digitalWrite(red, HIGH);
     delay (500);
     digitalWrite(buzz, LOW);
     digitalWrite(red, LOW);
     delay (500);
   }
    digitalWrite(buzz, LOW);
   delay(200);
   digitalWrite(buzz, HIGH);
   delay(200);
   digitalWrite(buzz, LOW);
   delay(200);
   digitalWrite(buzz, HIGH);
   delay(200);
   digitalWrite(buzz, LOW);
   delay(200);
   digitalWrite(buzz, HIGH);
   delay(200);
   digitalWrite(buzz, LOW);

   //if ((millis()- lastLongMeasureTime)>=5000)
   //{ lastLongMeasureTime = millis(); } //This is to update the lastLongMeasureTime with current time to prevent repetitive "cut the tape" message to be displayed.
}
  delay(150);
  /* This is the event */
 server.handleClient();

}
```