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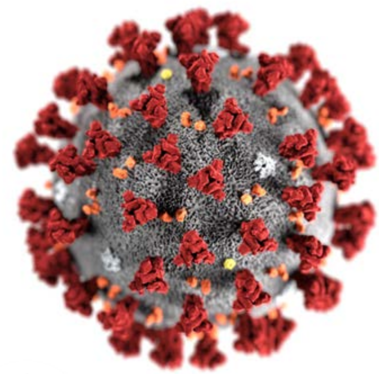
COVID-19/SARS-CoV-2 Surface Sampling



Test platform for detecting the presence of the virus on surfaces based on the CDC 2019-nCoV Real-Time RT-PCR Diagnostic Panel protocol

Extent and persistence

Assess and determine the extent and persistence of surface contamination with COVID-19/SARS-CoV-2.

Identify surfaces and fomites

Identify environmental surfaces which may play a role in onwards transmission of COVID-19/SARS-CoV-2.

Confirm disinfection practices

Confirm if disinfection practices are eliminating COVID-19/SARS-CoV-2 contamination from surfaces and fomites.

AEEC has access to multiple Government GWACs and IDIQs and possesses a DCAA Compliant Accounting System.
Our personnel capabilities include:

- **Certified Industrial Hygienists (CIH)**
- **Professional Engineers (P.E.)**
- **Data Scientists/Data Analyst & Cleared Resources**

Identification of COVID-19 contaminated surfaces will allow you to:

- **Flatten the curve**
- **Improve risk definition**
- **Implement and improve mitigation actions**
- **Health and Safety Assurance**

Surface Sampling Protocol Utilized:
World Health Organization Version 1.1
Surface sampling of coronavirus disease (COVID-19):
A practical “how to” protocol for health care and public health professionals.

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March 25, 2020

Flatten the Curve COVID-19 Mobile App ("FlattenCOVID19")

1 Brief Description

American Environmental and Engineering Consultants (AEEC), LLC proposes the development of a mobile application and public health data analytics platform using Google Cloud Platform to "flatten the curve" of the current COVID-19 pandemic. The mobile application will convey utility for the public at large, public health professionals and policymakers in enhancing case detection, enabling digital contact tracing, and acting as a data capture portal for critical health and social behavior data associated with COVID-19 that will be analyzed within Google Cloud Platform. The ultimate goal of this application and its associated analytical platform is to deliver evidence-based public health interventions, inform the public about needed measures to avoid disease transmission risks, and provide healthcare providers and public health officials with more accurate information about disease transmission dynamics that are currently unavailable. The solution is informed by earlier efforts by other countries (such as China, South Korea and Taiwan) to use digital and connected health technology to combat COVID-19. AEEC has teamed with health and technology firm S3, whose founders are renowned scientists at the University of California, San Diego School of Medicine and Public Health (hereinafter Team AEEC) to propose development of the application as outlined below.

2 Public Health Rationale

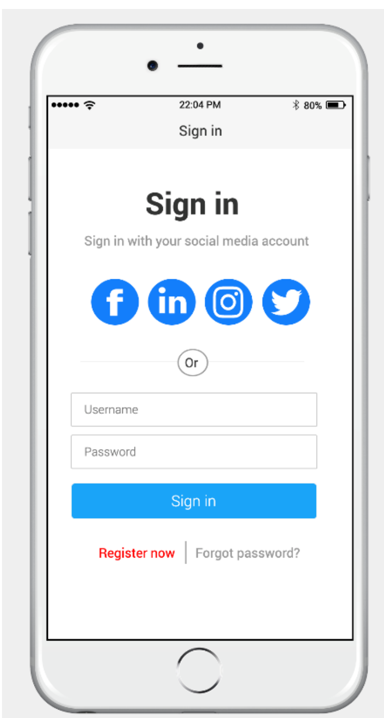
Currently, critical public health surveillance and behavioral health data about the COVID-19 outbreak is limited. This includes lack of resolution to the full scope and prevalence of the COVID-19 outbreak due to systemic lack of testing and diagnostic capability and the rapid spread of the disease. Though public health measures such as encouraging social distancing guidelines, curfews, restricting public gatherings, and "stay-at-home" orders are currently being rolled out by state and municipal governments in an attempt to flatten the epidemiological curve of the outbreak, basic information about the actual number of cases, attack rate of the disease in specific communities, and the actual impact of these interventions remains woefully inadequate. In response, technology innovations and crowdsourcing methods of public health data will become essential, including the use of mobile technology to collect, analyze, and deliver critical public health insights into the pandemic. Below we propose a solution concept that addresses these critical needs by collecting geolocated data directly from users who might be COVID-19 cases, tracking behavior and movement of potential cases that can be used later for "digital" contact tracing, providing the public with de-identified proximity alerts of crowdsourced information, and acting as a communications platform to alert users of risks and provide them with evidence-based information to positively impact health behavior.

3 Mobile Application Features.

Data collection will leverage four distinct sources of information (1) social media accounts, (2) surveying, (3) geospatial tracking, and (4) community-level characteristics.

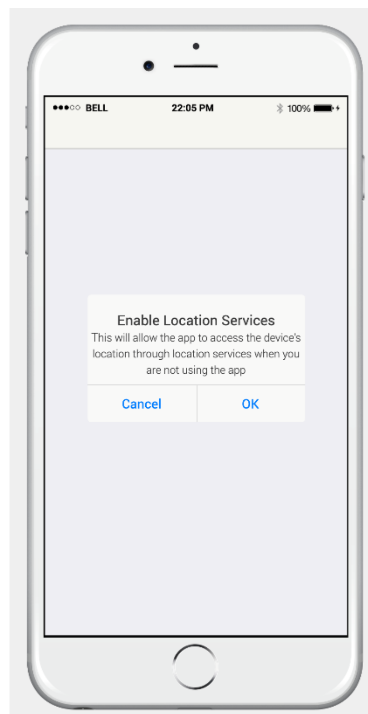
Data from social media accounts will be collected from the user's profile and posts upon registration with the application via social logins using available APIs of popular social media platforms (see concept **Screens 1-2**). Social media profile variables include available demographic factors such as gender, age, and education, occupation or place of work, geographic location, and social networks. For public accounts or based on certain privacy settings, social media posts and comments can also be collected in order to build profiles of COVID-19 risks (e.g. self-reporting of COVID-19 related symptoms, close contact with other possible cases, geotagging in hot spot areas, etc.). The purpose of ingesting linked social media data during the registration and sign in process will be to collect valuable metadata, as well as inform analytics-based classification of the potential risk of the user to COVID-19 transmission. Users will be given the option to connect Facebook, Twitter, Instagram, LinkedIn, and other popular social media accounts. Metadata and profile information will be used to populate registration fields and will feed into the analytical back end database in Google Cloud Platform. In the event of conflicting demographic information, the user will be prompted to correct the demographic entry.

At this point, users will also be prompted to enable geolocation services for the app (**Screen 3**). If the user elects not to allow this option, major functional components of the app will not be available to the user, though important baseline user profile and demographic data will be captured.



Screen 1: Registration

Screen 2: Social Login

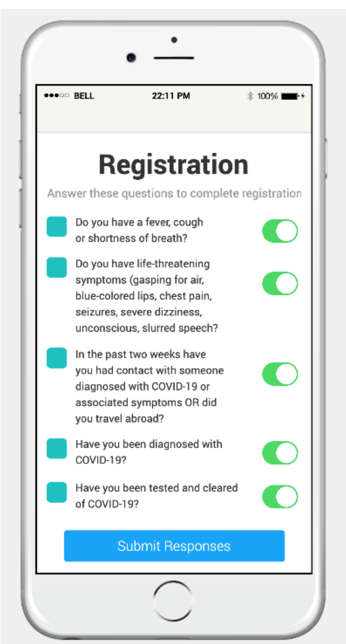


Screen 3: Geolocation

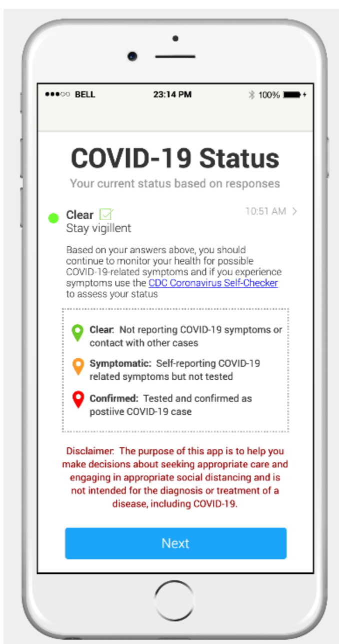
Upon logging into the mobile application for the first time, the user will be prompted to complete a short survey that assesses critical risk information relevant to COVID-19. Example questions are included on **Screen 4** and have been compiled from information provided on the CDC Coronavirus Self-Checker web application in a more streamlined and easier to toggle questionnaire. After users submit their responses, they will be directed to a screen that will create a classification of risk based on their self-reported responses, color coded as red (confirmed), yellow/orange (symptomatic), and green (clear) categories (**Screen 5**). Classification will include evidence-based guidelines on how to continue to monitor for symptoms, engage in social distancing, and provide information about available testing centers and treatment facilities based on the location of the user. Responses that would not classify users as high risk would trigger survey logic to show respondents questions that help analytical algorithms to differentiate between medium- and low-risk classifications. Risk of infection transmission is differentiated from risk of severe infection, which is assessed using a separate series of short questions such as those pertaining to pre-existing conditions. Furthermore, on a monthly basis, users will be prompted to complete another short survey to re-evaluate their COVID-19 risk status. If individuals were diagnosed with COVID-19, they will be asked to answer a short set of questions that provide information about symptomology, severity, and timeline. Further, users can submit supplemental information to confirm their status (e.g. COVID-19 testing results, etc.) which will be marked by checkbox to indicate additional documentation has verified their "clear" status. The overall objective of this classification system will be to get all users back to "clear" status.

Following registration and baseline survey, users will also be provided additional application features to enhance usability and adoption. This includes generating a unique QR code for each user tied to their application identity/account (**Screen 6**). This QR code can be tied to digital payment by adding it to a digital wallet, with each user that signs up for the application provided an incentive tied to the QR code and its use (discounts for consumer purchases, preloaded with credits, etc.). However, the QR code serves a dual function of tracking user movement and behavior and also enabling a quick scan to determine the self-reported status of a user by other users, healthcare providers, businesses, or other concerned parties. For example, China has successfully deployed a QR-code-like system to monitor cases and their behavior, with a similar approach used in this concept.

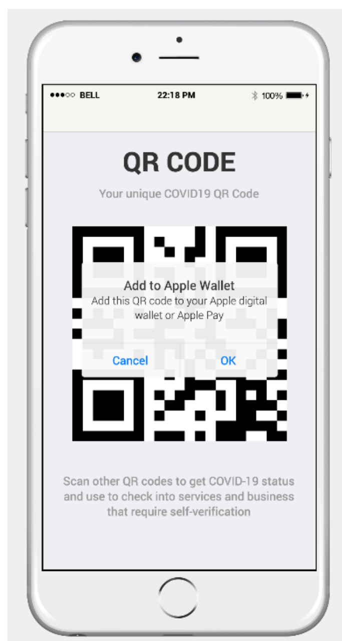
Users will also be given the option to invite their contacts to use the app with possible referral bonuses (**Screen 7**). This will enable snowball sampling-like methods to both increase the detection of possible cases and also encourage greater user adoption for purposes of crowdsourcing information directly from the public in a convenient way.



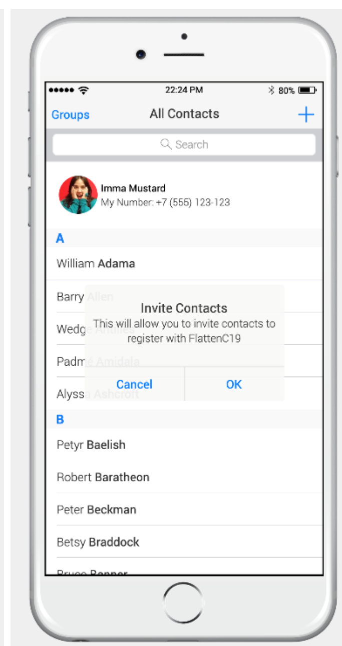
Screen 4: Baseline Survey



Screen 5: User Status



Screen 6: QR Code

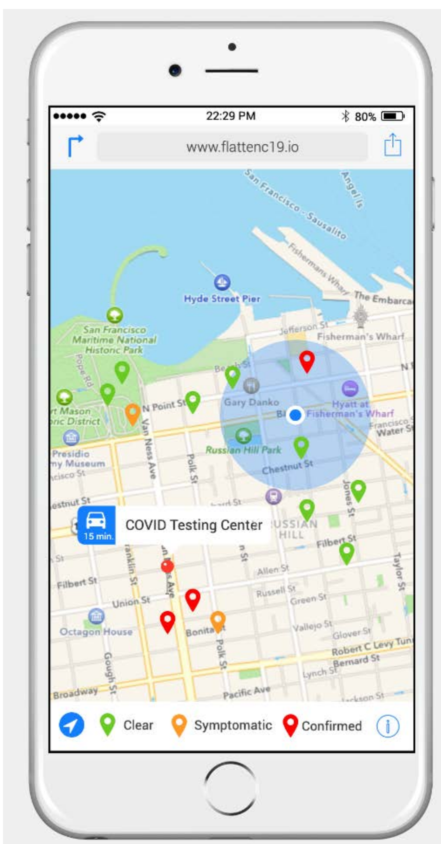


Screen 7: User Invites

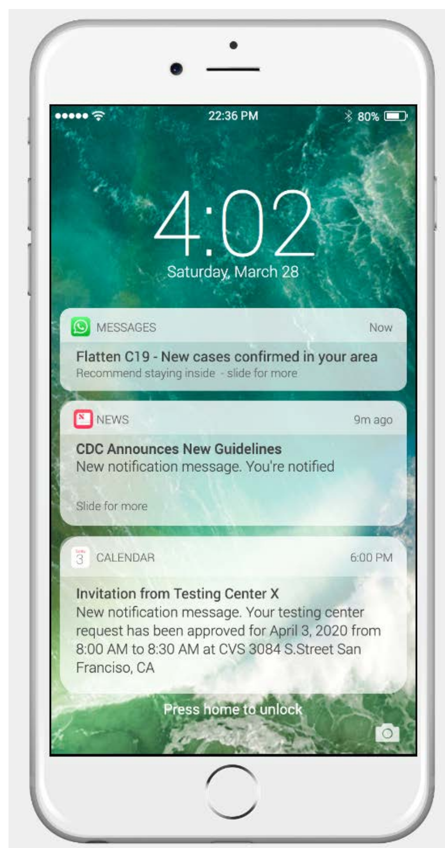
However, the utility of the application is the map it generates of the user and other crowdsourced information about other users and their status (see **Screen 8**). Critical to this function is anonymizing the data to the best extent possible, including stripping personal identifiers and possibly aggregating user points in certain geographic coordinates (versus exact geolocation). User information will include their risk classification (e.g. Red, Orange/Yellow, Green) and also provide additional information on the location of COVID-19 testing sites, healthcare facilities accepting cases, and other social services. This information will provide users with the information needed to make rational decisions about social distancing, self-quarantine, and adhering to state and local public health orders and mandates. Critical to the personal health and public health benefits of this application is the crowdsourced geospatial tracking of the apps user base. Upon reaching a critical mass of users, the geospatial distribution of the sample is expected to closely resemble the distribution of overall COVID-19 cases in a community, thereby permitting the user to resolutely understand areas of higher and lower risk. These data will be collected with timestamps in local time zones.

Collectively, the crowdsourced geolocated data generated by this applications (through user profile data, survey, QR code tracking, and active geolocation) will provide the analytical data layer needed to inform targeted public health interventions and critical health communication, including text messages notifying users when there are a cluster of cases in their proximity encouraging them to self-quarantine, push notifications of evidence-based information from trusted sources (to combat misinformation), and scheduling notification for testing and healthcare treatment appointments (**Screen 9**). App-derived crowd sourced information can also be augmented with higher resolution data from public health agencies (e.g. official case counts in communities) and other data sources as detailed in the next section.

As a concept solution, features such as social sharing, gamification, and user incentives will be critical to ensure broad user adoption and continued use. A clickable demo of this concept is available via share from Justinmind.



Screen 8: Crowdsourced Map



Screen 9: COVID-19 Notifications

4 Analytical Public Health Backend.

Perhaps the most valuable component of the concept solution is its backend data collection on Google Cloud Platfrom. Importantly, the data ingested by the Flatten the Curve app, will provide critical micro and macro insights to the COVID-19 outbreak at the individual patient, community and broader national level. To process this data, analytical approaches will be utilized to develop a set of algorithms to take ingested data and output simple information to multiple stakeholders (the user, healthcare providers, public health professionals, and policymakers). This includes information about the emergence of potential disease clusters, geospatial history of users and social contacts (again for contact tracing at the digital level instead of via interviews and self-recall), real-world evidence on the impact of public health measures and communication (e.g. location data on how individuals responded to stay-at-home orders or text messages suggesting self-quarantine), demographic data to model for disease risk and profiles, and longitudinal data to inform epidemiological progression and transition of COVID-19.

Importantly, this primary and secondary sourced data can be combined with community-level characteristics that can be derived from the US Census Bureau and the Centers for Disease Control and Prevention (CDC) and dedicated COVID-19 websites such as findcovidtesting.com and covidnearyou.org. Examples of variables from these data sources include the proportion of insured individuals in a zip code, proportion of non-English speakers in a zip code, and the historical levels of diseases with similar symptoms (e.g. influenza, rhinovirus) for the given time period in a zip code. These data will be joined by geographic features and can be used with statistical testing to examine associations and correlates between at-risk population or those more susceptible to transmission or poor outcomes based on social determinants of health.

Decision trees will be programmed to take survey data and output risk of infection with COVID-19 and also to output risk for high disease severity. For both of these, three levels of risk are possible: high (red), middle (yellow), and low (green). For the decision tree denoting risk of infection with COVID-19, baseline survey responses denoted in Screen 4 will greatly contribute to the classification of the user as high-risk. Negative responses to these questions will prompt a small set of additional survey questions about travel to nearby locations, assessed from GPS location. For example, the app will ask whether the respondent had visited the nearest ten grocery stores and gas stations, and then reference collected data on the number of high-risk individuals who had recently traveled to those locations.

Data collected from social media posts will also help to classify a user as medium-risk or low-risk. Posts collected within the last two weeks will be automatically ingested and scraped for certain keywords (e.g. “coughing,” “fever,” “tired”) and the user will be prompted with these posts to verify whether he/she has exhibited these symptoms. Decision trees denoting risk of high severity will not take infection risk into account, but rather would resolve the following question: “If you were to contract COVID-19, how severe would your sickness be?” Demographic information from social media accounts would be used in tandem with survey responses to classify the user as high-risk, medium-risk, or low-risk. To illustrate, an individual who is either immunocompromised or over age 60 would be classified as high-risk, an individual under age 60 with common pre-existing conditions (e.g. hypertension, hyperglycemia, smoker) would be classified as medium-risk, and an individual under age 60 without relevant pre-existing conditions would be classified as low-risk for severe sickness.

Individuals that have low risk of having been infected with COVID-19 are expected to garner additional utility from unique, data-driven recommendations that further keep infection risk low, especially if these individuals are of high risk for severe sickness. To accomplish this, the application will take information about localized risk in the community and relay this information to users. If the user has four grocery stores within a five-mile radius, the user would be interested to know if visiting one of these is especially risky for contracting COVID-19. The app can tabulate the proportion of high-risk users that have visited each of these stores in the previous day to denote whether any of these are especially risky. These statistics would refresh on a daily basis, as stores are expected to be cleaned especially frequently during the COVID pandemic. Broader community-based risk information will also be relayed to the user. The proportion of high-risk users in a given zip code is expected to fluctuate, and a moving average of this statistic can be relayed to the user in a simple way. In particular, the user will be interested to know whether conditions are worsening or improving in a given community. Simple projections, based upon average trends seen in similar communities around the country, can be relayed to the user to estimate whether conditions are expected to worsen or improve in the following 5-10 days.

The application will also be able to provide recommendations to users who are expected of having contracted COVID-19. Suggestions for nearby hospitals can be provided for users who are at high risk of disease severity, and recommendations to limit disease spread (and to alleviate symptoms) can be given to users who are at low severity risk.

These analytical layers can be used by healthcare professionals to better assess relative patient risk of COVID-19 infection when testing is not available or otherwise not feasible. Healthcare professionals can scan the QR code of the patient and with the patient's permission, access the full dataset of patient movement, social contacts, and self-reported symptoms, which will be aided by clinical-decision making software services powered by the Google Cloud Platform backend app database to assess patient risk at the point of care.

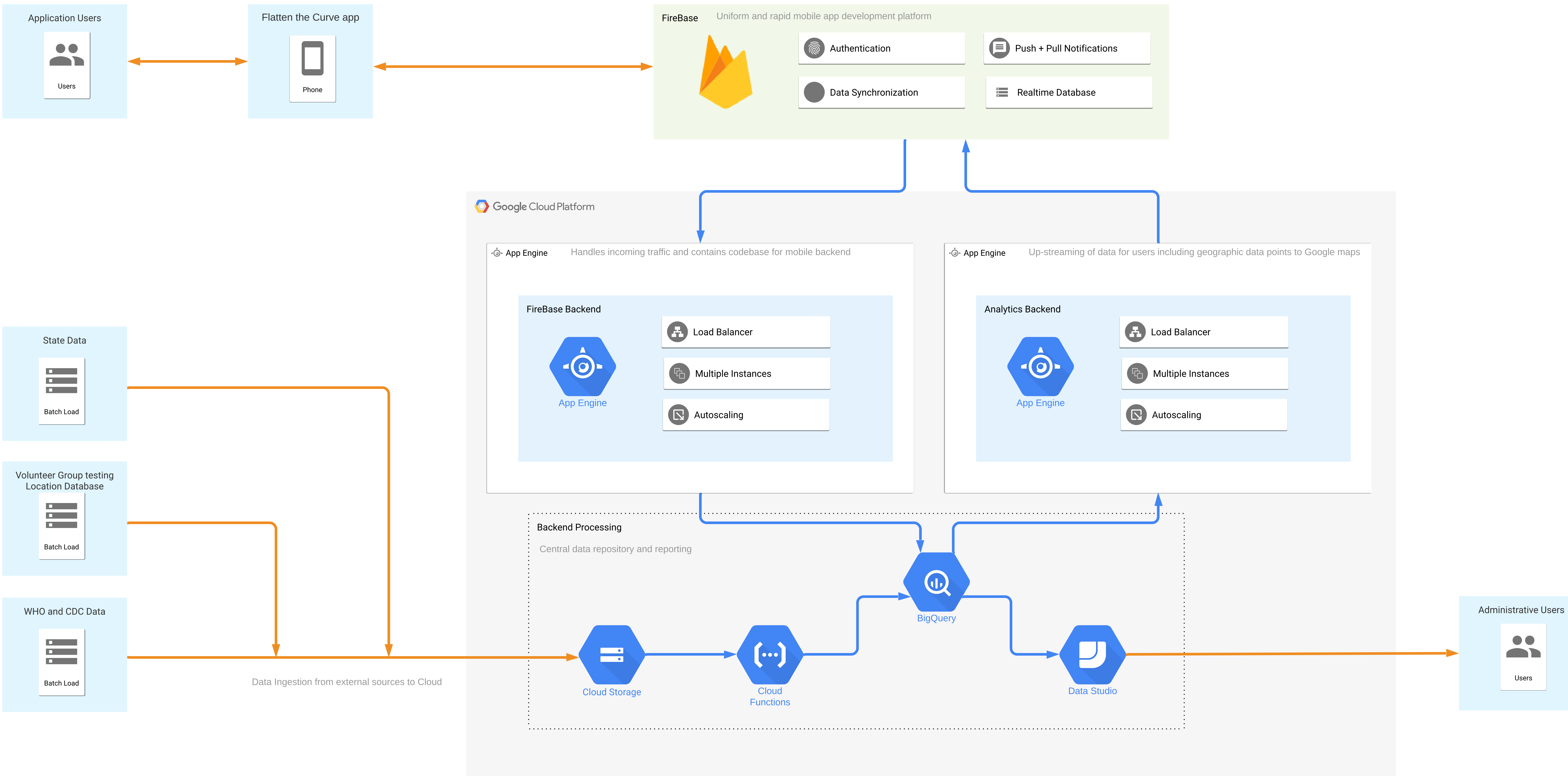
Equally, policymakers will have data at their fingertips to evaluate the effectiveness of COVID-19-related policies and countermeasures, and can better develop evidence-based policymaking at the community and national level to thwart progress of the outbreak based on data that is localized and actionable. This can also include identifying populations at high-risk that require additional testing access, require public service surge capacity, and may not be receiving or seeking necessary.

The attached technical architecture provides detail on how the backend data is ingested, output and processed. The Architecture is scalable and machine learning features are within the future plans of the application.

Attachment
Flatten the Curve Web App Architecture

Flatten the Curve WEB APP

AEEC | March 25, 2020



Proposal Architecture shall not be disclosed outside of the recipient and shall not be duplicated, used, or disclosed-whole or in part-for any purpose other than evaluation

Key Personnel Biographies

Timothy Mackey, MAS, PhD

Dr. Mackey is an Associate Professor in the Department of Anesthesiology and Division of Infectious Diseases and Global Public Health, the Director of Healthcare Research and Policy at USCD Extension, the Director of the Global Health Policy Institute, and CEO and Co-Founder of the health and technology startup company, S-3 Research LLC. Dr. Mackey has made a profound impact within the global health, big data and health policy communities with over 140 publications on disease control, health policy, machine learning, and IT utilization within the health environment. He has also acted as a consultant for the World Health Organization, the U.S. Department of State, and the U.S. Department of Justice among others and has previously received a grant from Google on the topic of illegal diversion of opioids. Dr. Mackey, has partnered with AEEC in the effort to help counteract the COVID-19 virus.

Raphael Cuomo, PhD, MPH, CPH, FRSPH

Dr. Cuomo is a public health scientist and assistant professor. He is published in numerous works, varying from ground-breaking cancer research to IT solutions for disease prevention. He has also been an active member of several professional public health organizations, including the American Public Health Association, the American College of Healthcare Executives, and Academy Health. Furthermore, he is a member of the health and technology start-up company, S-3. Dr. Cuomo, through S-3 and with Dr. Mackey, has partnered with AEEC to help engineer a counteracting solution for the COVID-19.

Cory Hixenbaugh

Mr. Hixenbaugh is the Program Manager of AEEC's Environmental and Engineering Division. He has over 14 years' experience in direct management of projects at the BP/ARCO Rico Mine Site, Hill Air Force Base (AFB) and other CERCLA sites in the western United States. He has 18+ years' experience in Performance Based Remediation, Long Term Monitoring (LTM) and Operations & Maintenance (O&M) activities. Cory is an expert in SCADA and telemetry for remote monitoring and control. His experience includes project oversight of field technicians and subcontractors

Kalem Sessions

Mr. Sessions is the Vice President of AEEC's Environmental and Engineering Division. He has over 18 years of experience providing environmental remediation and clean-up/closure services. He is experienced in addressing a variety of contaminants, and has implemented and supported a range of cleanup alternatives. Clients that he has supported include the US Department of Defense, US Department of Energy, US Department of Agriculture, and US Forest Service. Mr. Sessions holds BS degrees in Environmental Engineering and Public Health from Utah State University, an MS in Civil and Environmental Engineering from Stanford University, and an MBA from Brigham Young University. He is a Registered Professional Engineer in Utah

Key Personnel Biographies

Haiyang Li

Mr. Li's affinity for data science and tenure in problem solving has been recognized through two VP awards –one for successful rollout of a high visibility program that overhauls bulk mail entry customer service logistics across 63 pilot sites; the second for discovering a $1.2M revenue deficiency problem as a result of a system defect in electronic Verification System (eVS). He currently has a Bachelor of Science in Mathematics and Statistics from the University of Maryland. Regarded as a SAS and Statistics expert, Mr. Li has provided endless support through his programming, scripting, and data querying skills. As a Data Architect and certified GCP Data Engineer, Mr. Li served as one of the main developers in Team AEEC's solution.

Moloy Chatterjee

Mr. Chatterjee is a proven expert in AI strategies ranging from Base Models to complex Deep Learning, Complex Learning, and Machine Learning best Practices. Mr. Chatterjee has a Master of Science in Telecommunications from the University of Maryland. As a Lead Machine Learning Engineer, Mr. Chatterjee served as one of AEEC's main developers in creating our proposed mobile application solution.

Raj Patil, PE, CEO

Mr. Patil is the founder and CEO at American Consultants (AEEC) since its inception in 1995. AEEC's customers include the U.S. government and Fortune 50 companies across North America. Under his leadership, AEEC was listed on the Deloitte Technology Fast 500 list for four consecutive years. AEEC is also a winner of the Nunn-Perry award from the U.S. Department of Defense (DoD) and other accolades. Mr. Patil has a Master of Science (M.S.) degree in Chemical Engineering from Michigan Technological University (MTU). He is also a graduate of the Harvard Business School's (HBS) Owner President Management Program (OPM 42). Finally, Mr. Patil is a licensed Professional Engineer (P.E.) in the District of Columbia, Virginia, Maryland, Utah, and Wyoming.