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Original Article

An Effective Approach to Contact Tracing Applications for Covid-19

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Abstract *- As the COVID-19 pandemic has captured the country, states, and the entire world, technology is taking a step forward to prevent this danger and resolve the situation. The health authorities are taking some major technological support to trace the movement of the citizens at the most granular level to verify with whom they had contact over the given period. This helps to discover the contact with a Covid-19 positive patient to implement immediate quarantine measures and break the chain of the people exposed to the disease and minimize the count in high-density areas. This paper has proposed a system for effective contact-tracing in real-time using GPS and Bluetooth technology. Also, here is a study of such existing systems with their drawbacks and a proposed solution to overcome those limitations. Hence, the purpose is to provide a solution for combating the spread of Covid-19.*

Keywords *- Real-time tracing, Bluetooth Low-Energy [BLE], GPS, Contact-Tracing Application (CTA)*

I. INTRODUCTION

Covid-19 has caused a lot of loss of life and is continuing to do so, a lot of scientists believe that the virus is here to stay and we have to learn to live with it. The virus is a highly contagious disease with an above-average mortality rate; living with it sounds like a difficult task. This calls for some solution on how to live with a deadly virus amongst us.

Covid-19 prevention norms set by the World Health Organization says that you should maintain a social distance of at least 6ft, masks to be worn at all time and not touching the face frequently. But sometimes it's just not possible to maintain them. To keep the norms in check the government has come up with a technological solution to it, "Contact tracing mobile applications". These apps help the user in knowing whether they came in contact with a Covid-19 positive patient or not in the past 14 days. This majorly serves for effective contact tracing and warns the user of the infection he may contract. The main idea of these applications lies in logging the device information and location of the people the user comes in contact with. This data remains in the user's account database for 14 days. If any of the logged people are diagnosed with a contiguous disease the user gets notified for him to be cautious of the contingency [12][13]. Contact tracing is an intervention that plays an important role in the control of COVID-19. Contact tracing consists of three steps: contact identification, contact listing, contact follow-up [14].

Currently, the applications issued by the government have one major drawback – huge data requirement. The available application asks for a lot of data and users are skeptical about it. In this paper, we compare the existing or various proposed CTAs, which have been analyzed, and provide a solution for considering the gaps identified in those contact tracing applications [15]. One COVID 19 infection and contact tracing scenario are given below in Figure no 1.

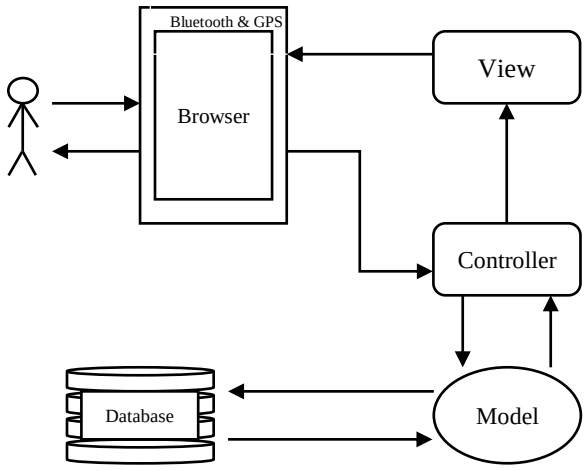

Fig. 1 High-Level Design

II. LITERATURE SURVEY

This study contains a survey of the digital contact tracing approaches applies for COVID-19 all over the world. Contact Tracing is done with the help of the following methods.

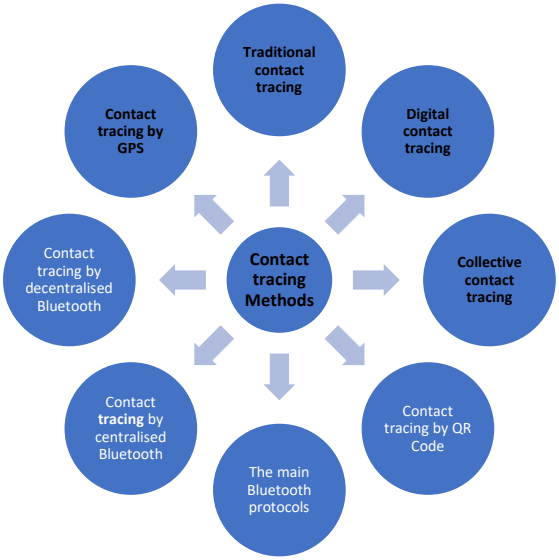

Fig. 2 Contact Tracing Method

It also analyses the selection of technologies used, data protection regulations, the role of private entities in the development of the application.

A. COVID-19 Contact Trace App Deployments: Learnings from Australia and Singapore [1][4]

This survey paper has identified the major concerns when it comes to a technological solution for contact tracing. It shows the studies of Singapore's TraceTogether and Australia's COVIDSafe contact tracing applications. It is found that the reach of the application is hampered due to three issues: Data Ownership, Trust, and Control. The apprehension of location data breaches and social networking data being misused are the concerns identified [8][9].

B. Bluetooth Smartphone Apps: Are they the most private and effective solution for COVID-19 contact tracing [2].

This paper deals with the central idea of maximizing the reach to almost 90% of the population by using a predictive model- The Bayesian model with already existing technological solutions under development. It identifies the stages in Contact-tracing and suggests different implementations for an effective CTA. The approach dwells on the study that the existing CTAs may or may not guarantee privacy-preservation and how to incorporate the calculation of the likelihood of getting infected. The proposed system puts to use Bluetooth and GPS technology.

C. Getting Behind COVID-19 Contact Trace Apps: The Google - Apple Partnership (DOI 10.1109/ MCE.2020.3002492, IEEE Consumer Electronics Magazine) [3]

The focus of this paper is on examining the role of Google and Apple in proposed smartphone-centric contact tracing capabilities in response to the novel coronavirus COVID-19.

D. Coronavirus Contact Tracing: Evaluating the Potential of Using Bluetooth Received Signal Strength for Proximity Detection [3][5][6]

The paper studies the various readings in the accuracy of the Bluetooth technology by following a scenario-based approach. It finds out that Bluetooth LE received signal strength can vary substantially depending on the relative orientation of handsets, on absorption by the human body, reflection/absorption of radio signals in buildings and trains. The findings can substantially help in contact tracing applications for improving the accuracy and for certain required assumptions[7][8][9][10][11].

III. PROPOSED ARCHITECTURE

The proposed architecture is a web application. It would help the users in the near real-time tracing of the contacted people. The main idea of the proposed system is similar to that of existing applications but keeping in mind the insecurity of data being shared. We would log the device information and location of the people the user comes in contact with. This data would remain in the user's account database for 14 days. If any of the logged people are diagnosed with a contiguous disease the user gets notified for him to be cautious and take self-care measures in compliance with the government prevention measures. Also, the project encapsulates the functionalities like finding the nearest hospital that provides the services for that disease along with the bed availability to ensure that the patient is sure of his choice. Also, to extend the scope of tracing the contacted people for users without smartphones a hardware system is proposed. This Bluetooth module hardware stores the data in its local memory and is synced with the browser once it is connected to any device's web browser so that the user database is maintained.

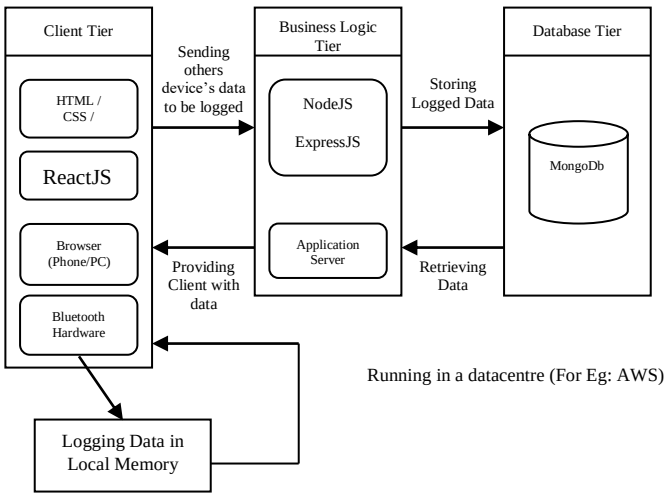

Fig. 3 Workflow of the proposed system

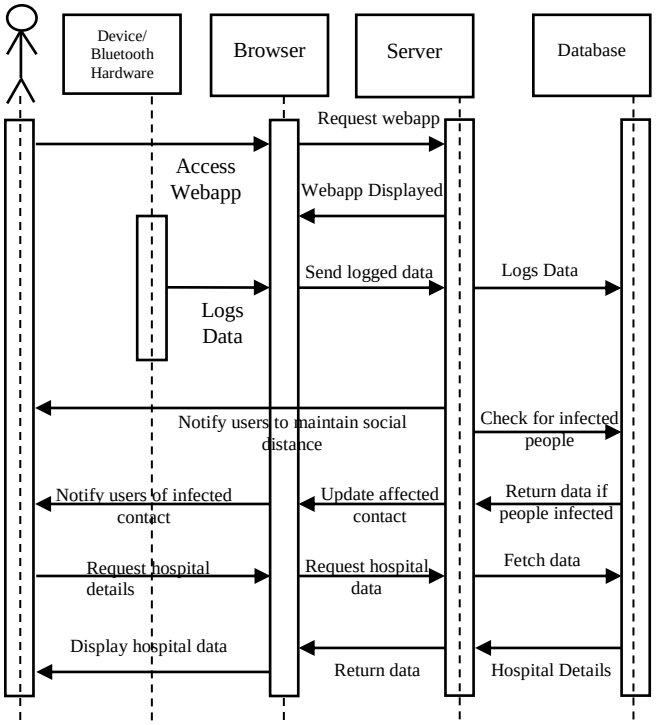

Fig. 4 System Sequence Diagram

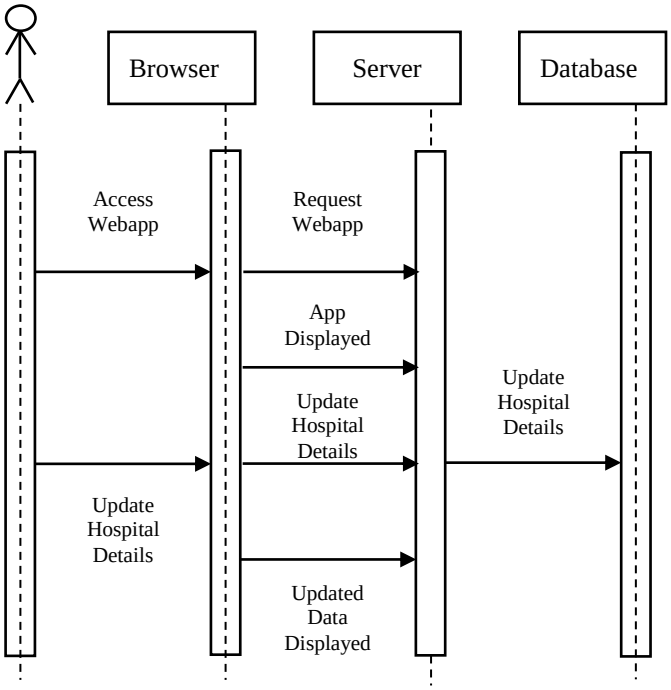

Fig. 5 Hospital Admin Sequence Diagram

The proposed hardware is a wristband developed out of an ESP-32 microcontroller. It has an inbuilt BLE, WiFi, and inbuilt flash memory of a capacity of 4MB. This is designed for expanding the spectrum of contact tracing to non-smartphone users. The tracing-band would handshake with the other person's tracing-band and would store the Unique ID of it in its internal memory. The device when paired with the user's account at home or any device through the web app it would sync the stored data to it.

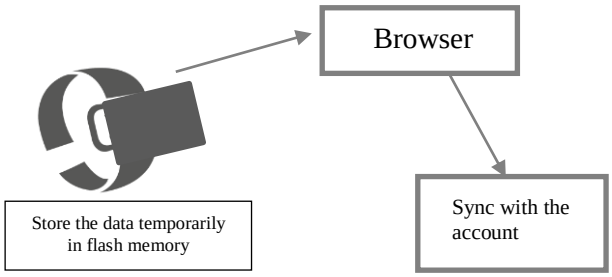

Fig. 6 Proposed Hardware Work-logic

IV. CONCLUSION AND FUTURE WORK

The system aims to ensure effective contact tracing that would help the people stay safe and cautious of their contraction to the virus. Despite the advances in medical treatments and vaccines under testing, the major concern till the entire population is immunized is contracting the infection through an infected patient. The hardware being developed besides is to expand the scope to all types of the population be it youth, middle-aged or old age. Similar strategies of contact tracing are implemented in the hardware as well keeping in mind the effectiveness of the technology existing. The system can be expanded in the future to any contagious disease spread or even to domains apart from Healthcare where contact-tracing is of use.

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