DivyaPay: Bridging the Digital Divide

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Abstract – The last two decades have witnessed remarkable technological inventions and advancements for solving the problems of humanity, thereby boosting the economy of the nation. Unfortunately, the avenue that deals with mitigating the hassles and challenges faced by people with disabilities or divyangjan, particularly in the financial field, is less explored. Nowadays, online transactions have become a necessity with the introduction of the Unified Payment Interface System, but people with physical disabilities lack the privilege to enjoy such a facility. This work proposes a system for divyangjans named DivyaPay, which is a Smartphone application for online payment built using Google's Flutter Framework and written using Dart Language. The App has primarily two interfaces for two different categories of disabilities: Biometric Authentication for a Visually Impaired person and FaceID Authentication for an Amputee. The presence of a haptic feedback system provides a better user experience. The smart voice navigation facility helps the visually impaired person to navigate through the App easily. Various payment APIs like Razorpay, Stripe, etc. can be integrated for a faster, smoother, and secured payment transaction. Thus, the proposed system, which targets to fulfill United Nations Sustainable Development Goals of Decent Work, Economic Growth and Reduced Inequalities, promotes the vision of Digital India amidst the physically disabled community by aiding them in performing cashless transactions safely and in a secured manner.

Keywords – Divyangjan; Digital India; Biometric Authentication; FaceID Authentication; Flutter; Dart

1. Introduction:

There are myriad difficulties and hardships that the physically disabled community has to face on a diurnal basis. From physical deformities to mental agony, a divyangjan has to suffer a lot of hassles that results in dependency on others in order to perform normal duties. Though nothing extraordinary can be accomplished with regards to the physical limitations of the human body, but research and innovation can create few provisions so that the life of a divyangjan can be made better and worth living independently.

As per the WHO report (World Health Organization, 2021), around 15% of the global population is differently abled. Women are more likely to experience disability compared to men. Low and Mid-low income countries suffer from higher rate of disabilities. One of the latest study on persons with disabilities by the Ministry of Statistics and Programme Implementation, Government of India earmarks India's disability population to be 2.2% of its total strength (Press Information Bureau, 2019). In the Business Disability Forum's report (Teaupa, 2015), the annual spending power of 12 million disabled people in the UK is about 212 billion Euros. Almost 75% of differently abled people walk away from making a purchase because they are unable to pay due to lack of facility. Moreover, 61% of government websites are not accessible by physically challenged users. Existing mobile banking applications are unable to provide equal accessibility to the differently abled. A lot of online payment applications, available nowadays, fail to cater to the requirements of a physically handicapped person so that he/she can also use the cashless transaction scheme.

This paper proposes a smart mobile application named 'DivyaPay', which aims to address the needs of a divyangjan to utilize the benefit of the 'Cashless Transaction' scheme so that a more secured and hassle-free life can be lived on his/her own terms with almost no dependency on other person. The primary objective is to engage the physically disabled person in an online transaction system without any extra charge. This will provide them the comfort of touch-and-pay and will help them live a life full of self-reliance and confidence.

2. Previous Related Works:

In the last few years, several research studies have been conducted to discuss the subject of discourse. For example; researchers (Sanjana & RejinaParvin, 2016) have proposed a text reading system that is used for visually impaired people by using Text-To-Speech (TTS) methods such as label reading, Pen aiding system, Brick pi reader and sentences based approach in order to make the printed text to be read and understood in an easier way. Moreover, (Sharma, 2014) has presented an assistive reading system for the visually disabled by using OCR and TTS modules but without a link with Near Field Communication (NFC).

NFC is a wireless connectivity which has evolved from the combination of contactless identification and interconnection technologies Radio-frequency identification (RFID) that uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored important information about the (product or service). It has a transfer rate up to 424 kbps. Its operation occurs when doing simple movements such as twist or swing in the distance between two NFC-enable devices which they are a closer connection between Zero and 10 CM. It does not need pairing code to link up. NFC communication technique is based on Tag-to-Tag protocols.

(Ubaya, 2012) has presented a scientific article that focuses on providing payment processing applications integrated with NFC technology but it is presented for the normal or healthy people. This system is based on the new trend of the Google's mobile Operating System i.e., Android. Moreover, it is designed to pay for the normal user side (nBelanja) as a consumer and the merchant side (nBayar) as a trader or seller by using the handset of Google Samsung Nexus S that already has NFC technology. Furthermore, this application is based on tag-to-tag protocol with Advanced Encryption System (ASE) security algorithm with 128-bit key length.

Text-based chatbots can perform various tasks ranging from booking a hotel reservation to paying a bill, thus making life easier for consumers (Vandana et al., 2019). The use of text as the input modality is a limitation since a keyboard is required at every point whenever a user (the blind) wants to communicate to the bot (Angga et al., 2015). Voice chatbots are considered more natural and efficient not only because it makes use of the most primary form of communication of humans i.e., speech or voice, but also aims to provide a more integrated customer experience with immediate verbal feedback, which allows users to multitask with ease. The use of voice chatbots adds a certain level of trust from the user to the service being used (Burri, 2018), thus increasing the usability and continuous operation of the service to customers (Hoffman et al., 2006).

Voice chatbots allow users to perform the task more quickly than typing and in the proposed system it is one of the necessities for the user. The number of tasks and applications of voice chatbots is limitless as it can be used in almost every sector, such as payment, health, commerce, and marketing. The advancement and integration of AI have brought new opportunities for payment services and platforms to create new methods of carrying out transactions (Fawthrop, 2019). Engaging in financial transactions using voice technology is now being explored by banks and other payment platforms. As PayPal pioneered the use of voice-activated payment systems in 2016, other banks and payment services have followed suit.

With the advent of digital technology in developed nations, developing countries such as Nigeria have failed to implement these digital services in its banking sector, thereby denying and depriving Blind customers the opportunity to engage independently with their finances (Samuel et al., 2020). However, the use of voice chatbot systems stirs-up questions bordering on the security measures put in place either by the use of fingerprint (biometric) authentication, a four-digit pin or by a biometric voiceprint (Nguyen, 2017), to ensure risk is reduced, and cases of fraud are prevented thereby improving the effectiveness and efficiency of the system. Improving on the current level of authentication in chatbots systems will push its adoption rate significantly higher (Anusuya & Katti, 2010).

According to (McLaughlin et al., 2002), the topic of transmitting the sense of touch over the Internet through the use of web applications has become increasingly more popular. Other researches have also proposed systems to enhance browser with haptic effects to enable the visually impaired to access the Internet (Kaklanis et al., 2010). Also, researches to improve web accessibility such as BrookesTalk, a text-to-speech system developed by (Powell et al., 1998) in an attempt to present web page overview to users by summarizing the content and a 3D audio based browser is created by (Donker et al., 2002) to convey web content.

3. Proposed Methodology:

A. Overview of the Proposed System

In the proposed system, the problems faced by any physically challenged person related to payments have been addressed in two ways:

1. For the blind, a haptic enabled and voice automated payment interface is provided along with Biometric Authentication. The blind user will be able to navigate easily through the app using the haptic feedback or voice commands.
2. For the amputee, a voice automated payment interface has been provided similar to the interface of the blind but instead of the biometric authentication, Face Authentication will be provided. For the amputee users, Biometric Authentication is not possible, hence Face Authentication feature is provided for a better security.

The proposed payment app named DivyaPay can be integrated with RazorPay, Stripe and other payment APIs for a faster, secured and smoother transaction process.

B. System Architecture

After thorough research in the field of payment application about the problems faced by the people with disabilities and various other platforms that ease out any kind of process or transaction of the disabled people, an architectural framework in the form of a two interface solution for the two different categories of users has been proposed (see Fig. 1).

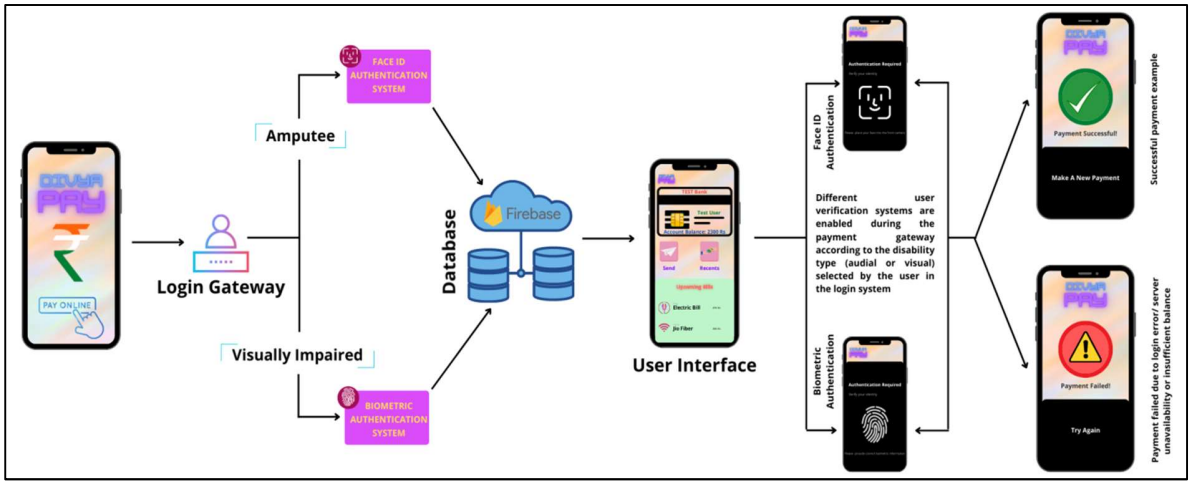

Fig. 1 Architectural framework of the proposed system named 'DivyaPay'

C. Working Principle

The proposed App has two interfaces- one for the visually impaired individual and the other for an amputee. An AI chatbot is integrated with the system using which one can navigate through the app using voice commands. In the first instance, the user needs to link the app with the Bank details as a normal user does on any payment app. After that he/she needs to provide authentication details preferably fingerprint details as biometric details by visually impaired users, whereas the amputee needs to provide his/her facial image or picture from different angles for FaceID Authentication.

Once the users are done with the authentication, they are ready to start with the payment process. Razorpay, Stripe and other various payment APIs will provide a smooth and secured transaction along with FaceID Authentication or Biometric Authentication during the transaction.

4. Implementation & Result:

DivyaPay is available both on Android and iOS devices. The proposed solution is implemented in an Android App using the Flutter Framework for cross platform support. Local auth flutter package is used for the authentication part, especially for security authentication. For haptic feedback, the vibration flutter package has been integrated within the app. Text to Speech Flutter package is used for voice response. Various other necessary packages can be imported from time to time to improve the user experience and to manage the app efficiently. Technology Stacks used here is Flutter, for developing a cross platform user interface.

The payment process will be driven using the Flutter Stripe API along with other APIs like Razorpay, PayG, Paytm and Cash Free. These APIs will ensure proper security during a transaction. The voice automation is integrated using a third party chatbot named Alan AI. This chatbot is integrated with the proposed app for voice command driven operation and navigation during the payment process. The following figures (Fig. 2 and Fig. 3) present the screenshots of DivyaPay's interfaces for a visually impaired divyangjan and an amputee respectively. Fig. 4 and Fig. 5 respectively show the screenshots of successful and failed transactions by the divyangjan.

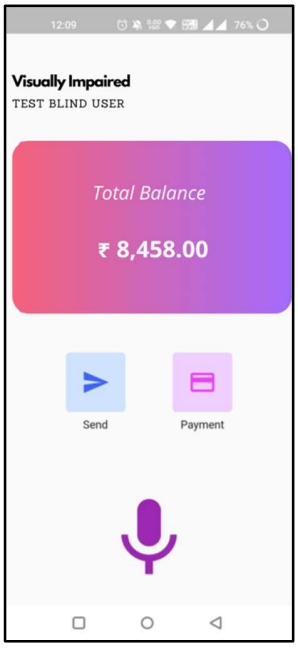

Fig. 2 Interface for Visually Impaired

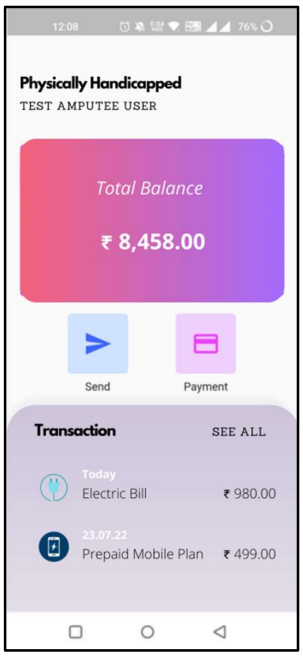

Fig. 3 Interface for Amputee

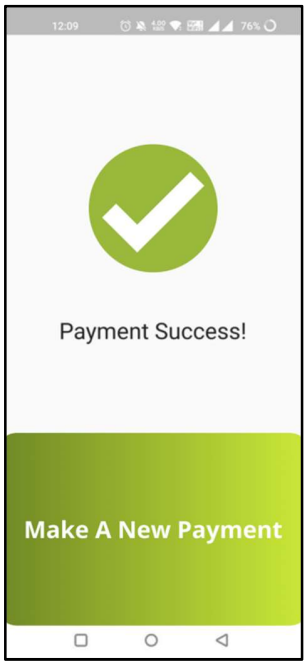

Fig. 4 Payment Successful screenshot

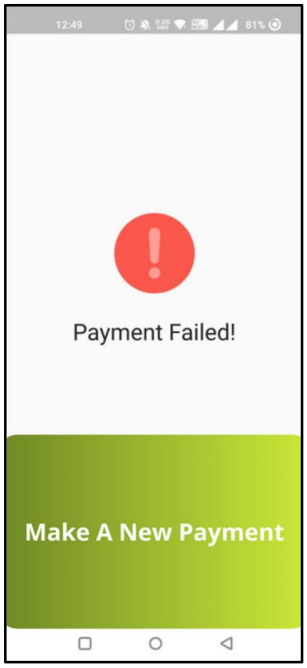

Fig. 5 Payment Failed screenshot

5. Discussion & Analysis:

Such a problem statement is selected due to some real life experiences that people often overlook whenever they step outside of their homes. People do not bother much about the welfare of the physically handicapped people. Almost everyone uses Google Pay, Phone Pay, and Paytm nowadays but a thought like 'How the physically challenged person can pay digitally?' seldom crosses the mind. So the task of solving the problem faced by physically handicapped people to pay digitally was taken up. Through DivyaPay, the following key objectives are met:

I. The physically challenged people will be benefited greatly in the online transaction field after the launch of this app.
II. Different types of authentication systems can be taken into consideration for the use of various kinds of physically challenged people.
III. The digitalization of cash will be increased manifolds with the introduction of this application, thereby bridging the digital divide faced by a divyangjan.

The USP of the solution is that such a solution is not available in the market currently and no such payment gateway application has been developed as yet. DivyaPay aids a physically disabled people in enjoying the cashless transaction facility and for making secure payments within a few seconds.

6. Risk & Mitigation Plan:

There is a high risk that fraudsters might scam the physically handicapped people, especially the blind and the amputees. So, to mitigate this issue, a voice enabled interface is being developed which will check and filter out any kind of scams or fraudulence activity.

7. Conclusion:

DivyaPay App primarily focuses on resolving the problems faced by the people who are physically disabled and are not able enjoy the cashless transaction facility. The proposed app ensures that any divyangjan or user enjoys the cashless transaction scheme and is able to participate in the digital sphere of India. This app will not only provide an edge over the cashless hassle free transaction but will also motivate the upcoming generations to come up with new ideas to help the society. People who are physically disabled are not lucky like a normally fit person and lead a difficult life but through DivyaPay the aim is to ease out a bit of their hardships by introducing such an App for their daily payment need.

8. Future Scope:

The DivyaPay Application will prove to be an effective payment app for a divyangjan or a physically challenged person. Few enhancements in the proposed work have been identified. Gift and Rewards for the physically challenged user in the form of coupons, vouchers and cashbacks can be introduced. Audio Visual Quizzes will be scheduled for the users which will keep them engaged

with the application. Special rewards will be provided on winning those quizzes. Referral system will be introduced to engage a chain of people and this chain will flow further to a greater extent. Collaboration with other companies for providing discounts, coupons, scratch-cards etc. just like Google Pay, PhonePe or BharatPay can be integrated with this application. Such a structure will give a boost to the socio-economic scenario of the society and will prove to be a prime source of revenue generation as more number of users are aligned to the mission. Furthermore, the companies collaborating with DivyaPay for the coupons will be charged for the merger. Several NGOs can also be part of the proposed application and special events can be arranged for top users of the app or for users chosen from lucky draw games.

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