

## **Voice Based E-Prescription: A System for Appointment Booking, Prescribing and EHR**

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### **Abstract**

*COVID-19 Pandemic has changed the lifestyle of most of the people and one of the changes is meeting anyone in person. People in remote areas have difficulty traveling to a clinic. But as of now, most of the consultations are done online / over the phone, which results in miscommunication of the medicines prescribed. Also if the patient forgets the medicine name, dosage, he /she has to keep contacting the doctor again and again. Our idea mainly focuses on eliminating these errors and helping the doctors generate prescriptions by voice commands and send the same to the patient as SMS/PDF.*

### **Keywords**

*E-Prescription, voice to text,*

### **I. INTRODUCTION**

The outbreak of Novel Coronavirus disease is a grave menace to the entire world affecting millions of people. Massive annual conferences to small organization meetings alike have moved to the online mode. The new format (online mode) poses numerous profound and organizational challenges, but it furthermore offers opportunities. Our application helps in reaching out to patients virtually and consulting them. Also, adverse drug effects are a major cause of death in the world considering tens of thousands deaths up across the world each year because of medication or prescription errors. Many of such errors have an effect on the administration of the muddled drug or dosage by caregivers to patients due to indecipherable handwritings, drug interactions, and nebulous drug names. The adoption of voice-based e-prescription could eliminate some of these errors because they allow prescription information to be recorded as a voice and in turn heard through voice response rather than in the doctor's handwriting. This project presents a design and implementation of a voice-based E-Prescription along with the ability to book appointments using the IVR system as the main idea. This application helps the doctors to generate patient prescriptions using voice commands and send the same as an SMS for people who do not have the facility of a smartphone or as a pdf to the patients over social media. Furthermore, the application has features wherein the doctors can access records of patients and send messages. Patients can book appointments based on doctors' availability on our app or using the IVR system

## II. LITERATURE SURVEY

**Table 1**

Attributes	Tata health	E-sanjeevini	Proposed System (Voice Based E-Prescription)
E-Prescription generation (by Voice/manual)	Manual	Manual	Voice
Appointments	Yes	Yes	Yes
IVR Service	No	No	Yes
Prescription sending format	In App	Link	SMS / Social Media App/ In App
Access to E-prescriptions and audio prescriptions	E-prescription	E-prescription	E-prescription and audio prescription
Video Call	Yes	Yes	No
Link to the App	<a href="https://www.tatahealth.com/">https://www.tatahealth.com/</a>	<a href="https://esanjeevanipd.in/">https://esanjeevanipd.in/</a>	In Progress

**Table 2**

Attributes	Tele Arogya	Board Of Doctors	Proposed System (Voice Based E-Prescription)
E-Prescription generation (by Voice/manual)	Manual	Manual	Voice
Appointments	Yes	Yes	Yes
IVR Service	No	No	Yes
Prescription sending format	In App	In App	SMS / Social Media App/ In App
Access to E-prescriptions and audio prescriptions	E-prescription	E-prescription	E-prescription and audio prescription
Video Call	Yes	Yes	No
Link to the App	<a href="https://telearogya.com/">https://telearogya.com/</a>	<a href="https://boardofdoctors.com/">https://boardofdoctors.com/</a>	In Progress

For the Literature Survey, Tata health, E-sanjeevini, Tele Arogya and Board of Doctors are taken into consideration. All of the compared applications are up and running. In these applications, the prescription generation is manual unlike the proposed system. All the applications have an option to book appointments online but the proposed system not only gives the option to book consultations online but also gives option for the non-smartphone users to book consultations via the IVR service. This IVR service is unique to our proposed system. All of these applications generate E-prescription but the proposed system not only generates E-prescription but also generated audio prescriptions and these are stored in the application itself, which can be accessible to the patients with smartphone or without smartphone. The non-smartphone users can fetch their audio prescriptions via the IVR service. Most of the mentioned applications have video consulting which is not the provided option in the proposed system.

Finally, after comparing with the related work it can be told that the existing systems offer consultation facilities but it limits its facilities to only high end devices like smartphone/PC users. In the proposed system, all the users will have to go through a onetime

registration process, which helps the system maintain patients' profiles as well as classify smartphone and basic cell phone users.

### III. SYSTEM DESIGN AND IMPLEMENTATION

Once the user is registered, he/she can,

1. Book appointments
2. View prescriptions
3. Hear the audio version of the prescription

The Method is to process an audio file of prescription and reach out to people with smartphones or those with basic cell phones. The system has 2 major entities

#### 3.1 Converting the audio file to Text format and sending it as PDF/SMS to the patient

The way a prescription is sent to the patient is by transcribing the audio instructions given by the doctor and formatting that into an SMS body. The border condition with respect to the number of characters in a single SMS is also taken care of.

#### 3.2 Storing the audio file of prescription in the database

The audio file can be played either on the application or through the IVR system. In IVR technology people interact with an application through pre-recorded voice messages with Dual-tone multi-frequency signaling (DTMF) input using a keypad. IVR system interacts with callers, gathers some essential information, and routes calls to the appropriate agents. In this use case, the IVR system helps users in booking appointments, playing recorded prescriptions in Database.

#### 3.3 Resulting improvements

The proposed system not only helps a lot of people with basic cell phones, but also people with hearing aid. The people who have hearing aids might not have heard some important details during the consultation and those details wouldn't be appropriate in a prescription like, the diet prescribed by the doctor to the patient or an exercise.

In This model, there are 5 main components i.e.,

1. Patient
2. Doctor
3. Appointments
4. Consultation
5. Slot Booking

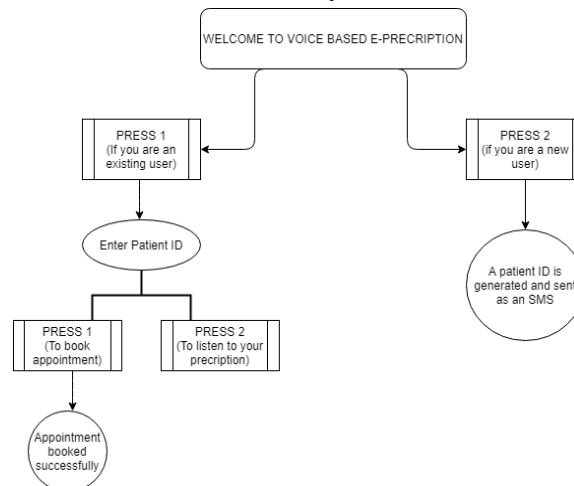
<p><b>Patient:</b> Patient participant object has the following attributes:</p> <ul style="list-style-type: none"> <li>• Patient Id</li> <li>• Name</li> <li>• Age</li> <li>• Mobile</li> <li>• Email</li> <li>• Gender (optional)</li> </ul>	<p><b>Consultations</b></p> <p>Appointment has the following attributes:</p> <ul style="list-style-type: none"> <li>• Consultation Id</li> <li>• Booking Id</li> <li>• Consultation Date and Time</li> <li>• Pdf of the prescription</li> <li>• Audio of the prescription</li> </ul>
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<p><b>Doctor:</b> Doctor participant object has the following attributes:</p> <ul style="list-style-type: none"> <li>• Doctor Id</li> <li>• Name</li> <li>• Phone Number</li> <li>• Email</li> <li>• Role</li> <li>• Signature</li> </ul> <p><b>Appointments:</b> Appointment has the following attributes:</p> <ul style="list-style-type: none"> <li>• Booking Id</li> <li>• Booking Date</li> <li>• Start Time</li> <li>• End Time</li> </ul>	<p><b>Slot Booking</b></p> <p>Slot Booking has the following attributes:</p> <ul style="list-style-type: none"> <li>• Slot Number</li> <li>• Slot Start Time</li> <li>• Slot End Time</li> <li>• If the slot is booked or not</li> </ul>
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The patient first registers himself on the application, irrespective of the phone he uses. Once he is a user he can book slots based on his convenience and also based on the slots the doctor’s availability. After the conversation between the patient and doctor, the doctor ends the call and creates a prescription using voice commands. Then, the generated over prescription is updated in the patients database which he can access anytime through the application. For the non- Speech smartphone users, he/she can listen to the audio prescription as using the IVR service and a SMS of the same is sent to his mobile.

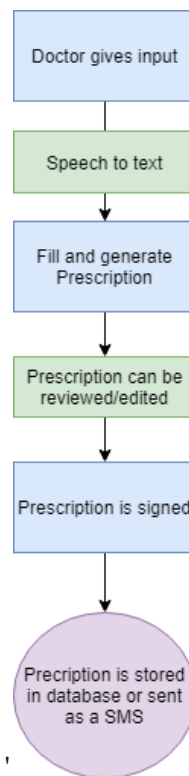
### 3.4 The IVR system

As seen in the previous sections Interactive Voice Response (IVR) is basically an automated phone system which allows incoming callers to access information via a voice response system of previously recorded messages without having to speak to a person or an agent, as well as to make use of menu options via keypad selection or speech recognition through which their call can be routed to a specific department or particular specialists. The below figure gives a brief view on how the IVR system works in this application.



**Figure 1: IVR Flow**

As seen in this proposed system the doctor can generate prescription with voice commands and the flow of the same is shown below



**Figure 2: Prescription Generation Flow**

The doctor starts the process of this application by hovering over the textbox provided and starts dictating the prescription. The application records the speech with the help of Google Speech API as a recognizer which is done on a real time basis and fills the prescription containing various categories such as Diagnosis, medication, time of the medication to be taken, dosage and also advice if needed. A PDF document of the Prescription will be saved which is accessible to the patients via the application or via the IVR system (audio prescription).

### 3.5 Tools and Technologies

The tools and technologies used to build this application are Adobe XD: This is also known as Adobe Experience Design. It is a vector-based user experience design tool for web apps and mobile apps. This is used to give a better user interface.

**React JS:** It's basically used for handling the view layer for mobile apps and web apps and this is an open-source JavaScript library which is basically used for building user interfaces mainly focused on building single-page applications.

**Node JS:** This mainly executes JavaScript code outside a web browser. Another feature is that it lets the developers use JavaScript to write command line tools and for server side scripting this is also helped in running scripts on server-side to produce dynamic web pages before the page is sent to the user's web browser. As known it is an open source, back-end, cross-platform JavaScript runtime environment which basically runs on the V8 engine.

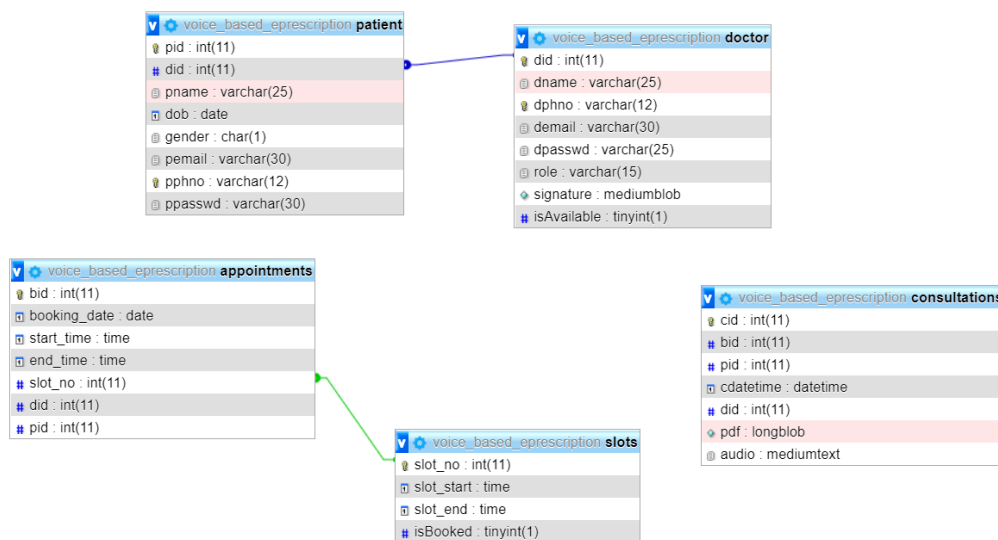
**MySQL:** The application of MySQL is used for a wide range of purposes, including e-commerce, data warehousing, and logging applications. This basically is a relational database management system based on Structured Query Language (SQL).

**Postman:** This is an API client. That makes it easy for developers like us to share, test, create and document APIs. This is done by creating and saving simple and complexity/s requests, and also reading their responses. The result of this would be less tedious work and a more efficient process.

**Google speech to text API:** The Google Speech API which is popularly known as Cloud Speech-to-Text which is sophisticated tool that uses Google's machine learning technology to convert **voice to text**. In this particular application speech to text is done while generating prescriptions, which is one of the main aspects.

**Web kit speech recognition API:** This basically handles the Speech Recognition Event which is sent from the recognition service module. The Speech Recognition interface of the Web Speech API is nothing but the controller interface for their cognition service which is available.

**Twilit:** This is a Messaging API which can send and receive MMS, OTT, SMS messages globally. It basically uses intelligent sending features to ensure messages reliably reach end users wherever they are without much process and glitches. The proposed system uses Adobe XD to design the UI. React JS and Bootstrap to build the front end. Node is and MySQL for back end. Testing is done on postman. The whole application is deployed on AWS. Some of the APIs are google speech-to-text API and also web kit speech recognition API .For sending SMS through the IVR, twilit SMS is used.



**Figure 3: ER Diagram**

The figure shows the ER diagram of the database which is used for building the web app. It has 5 tables, patient, doctor, appointments, consultations, slots. Here, as seen that some of the tables are connected to each other with the foreign keys and primary keys.

#### IV. RESULTS

Due to the current Covid-19 Pandemic most of the consultations are done online/over a phone call due to which there are chances of having miscommunication. Our idea mainly focuses on eliminating these problems and helping the doctors generate E-prescription by voice commands and send the same to the patient as SMS/PDF. In this proposed system, formatted prescriptions are generated based on voice Commands from the doctor. The prescription is accessible to the patient via the application for the smartphone users and as an SMS for non-smartphone users. The audio version of the prescription will also be available in the application.

##### 4.1 A brief of the project

1. Doctors can create formatted prescriptions with voice Commands.
2. Doctors can read prescriptions if their reference is present in the doctors array of prescription objects.
3. Patients can either book the appointment using the IVR module or the app itself.
4. A patient can access his audio prescriptions via the IVR module or the application itself.
5. A patient can read and access the prescriptions. As they are accessible via PDF/SMS.

##### 4.2 Advantages of the proposed system

- Save Time and energy by just speaking to the application rather than writing it on a sheet of paper
- save paper by generating digital prescription which can be viewed directly from the application
- Handwriting of the doctor is not a problem anymore.
- Easy access to retrieve patient prescriptions.
- Medication errors are reduced.
- helping people with hearing aids.
- Sending prescriptions to people with or without smartphones.
- Contactless consultation-helps reduce human contact which results in safer experience.

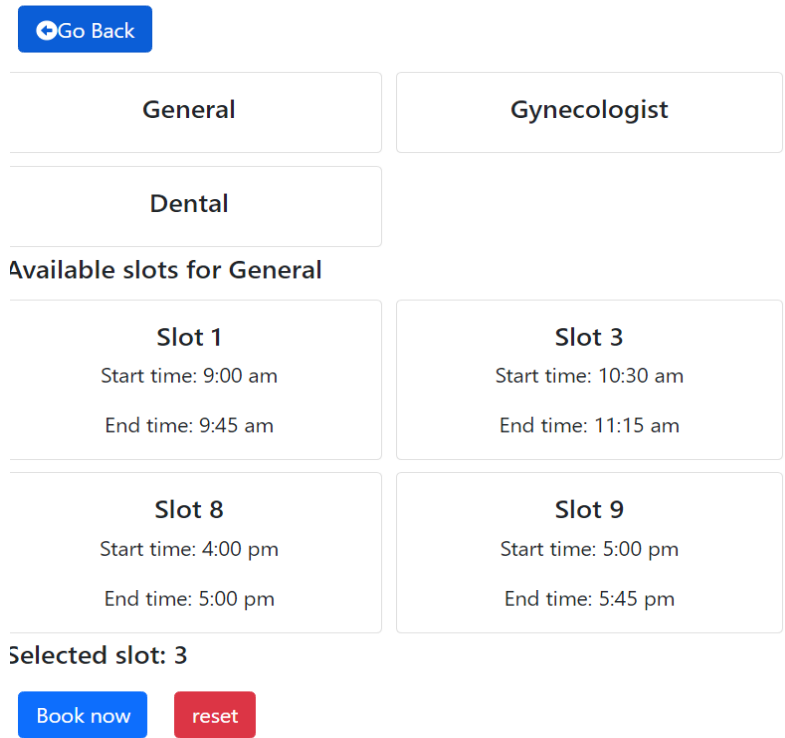
#### V. SNAPSHOTS

Dashboard Appointments Doctors Book an appointment

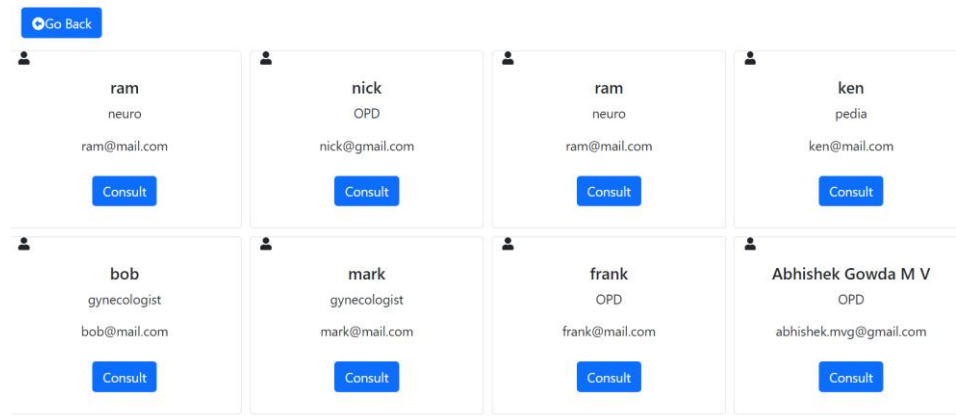
SAM-1 LOGOUT

Appointment No	Doctor name	Problem	Date	Timings
92	john	orthopedic	Jul 10th, 21	01:45 pm - 02:30 pm
93	ross	neurosurgeon	Jul 10th, 21	09:45 am - 10:30 am
94	pete	dental	Jul 10th, 21	05:45 pm - 06:30 pm

**Figure 4: Appointments Booked by Patient**



**Figure 5: Slot Booking based on Category**



**Figure 6: Slot Booking based on Doctor**

Consultation No	Patient name	Date & time	View	Download	Audio
2	ram	3:17 am, Jul 5th 21			
3	Abhishek Gowda M V	2:14 am, Jul 7th 21			
4	Abhishek Gowda M V	3:40 am, Jul 7th 21			
12	Abhishek Gowda M V	4:49 am, Jul 7th 21			
13	Abhishek Gowda M V	4:58 am, Jul 7th 21			

**Figure 7: Doctor Dashboard**



Appointment ID	Patient ID	Patient name	Slot	Date & time	Action
91	60	Abhishek Gowda M V	7	Jul 8th, 02:30 pm	<a href="#">Make prescription</a>

**Figure 8: Doctor Appointment Page**

We can view the appointments he has for the day and make a prescription after the call with that particular patient, a buttons given in order to make a prescription as shown in the Fig 5. In the prescription generation page the doctor can hover over the given fields and enter the values needed via **voice**.

Dr. john  
Orthopedic  
john@email.com  
9123132122

**Name:** sam  
**AGE:** 3  
**Gender:** M  
**PID:** 1

**Date:** 10 Jul, 2021

Rx	Frequency	Duration	Quantity

Diagnosis:  Listening... Add signature Save

Medicine:

Frequency:  AF/BF:

Duration:

Quantity:

Add advice

**Figure 9: Prescription Generation Page**

Dr. john  
Orthopedic  
john@email.com  
9123132122

**Name:** sam  
**AGE:** 3  
**Gender:** M  
**PID:** 1

**Date:** 10 Jul, 2021

**Diagnosis:** Fever cold and cough

Rx	Frequency	Duration	Quantity	
1	Paracetamol	1-0-0 ( after food )	2 days	500mg
2	Benadryl	0-1-0 ( after food )	3 days	10ml

ADVICE TO PATIENT:  
Avoid dairy products and citrus fruits. Take Steam every day

**Figure 10: Final Prescription Page**

The above Snapshots give an overview of how the application looks and also the different components present. Once the patient registers and logs in he sees the dashboard where he can book a new appointment and after he books anew appointment he can view that in the main page as shown in Fig 1. The patient can book appointments based on the category as shown in Fig 2 or also book it based on the choice of doctors as shown in Fig 3. After the patient books an appointment the doctor can view it in his dashboard as seen in Fig 5. All the details of the previous consultations done by that particular doctor can be viewed in his dashboard, he can also view/listen to the prescription that he had generated for the patient as shown in Fig 4. The doctor As shown in Fig 6, the highlighted word “listening” shows that it is ready to take in voice commands given by the doctor and the doctor can fill in the details such as diagnosis, medication, frequency, duration and also quantity. Finally, he can add advice to the patients if any. After entering all the details he can add his signature which he would have given at The time of registration. The final voice generated prescription would look like Fig 7.

## VI. CONCLUSIONS AND FUTURE ENHANCEMENTS

The proposed and implemented system aims to reduce the amount of time consumed in creating and accessing patient records. This Application is available to all the doctors plus patients with smartphone or without smartphone. The implemented application is a very unique solution to solve the problem of illegible handwritten prescriptions and also a great solution to get consultations done during a pandemic like covid-19. Voice-based e-prescription needs a minimal fine-exposure in the workflow of a doctor but in the long run, it will make a gigantic impact in developing a digital ecosystem for patients. The implemented system will shorten the patient folder entry time and retain high security and privacy of uncomplaining data. In the long run, There is a plan to unite and use the system in the valid hospital ecosystem to test and validate the implementation and to analyze the impact it will create in the healthcare domain.

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