University of Ibadan Journal of Science and Logics in ICT Research (UIJSLICTR)

ISSN: 2714-3627

A Journal of the Faculty of Computing, University of Ibadan, Ibadan, Nigeria

Volume 15 No. 1, September 2025

journals.ui.edu.ng/uijslictr
http://uijslictr.org.ng/
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University of Ibadan
Journal of Science and Logics in ICT Research

Development of an Android-Based MedicalBot to Diagnose and Suggest Remedies for Tuberculosis

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Abstract
Tuberculosis (TB) is one of the top ten causes of death worldwide and the leading cause of death from an infectious disease. TB is an airborne bacterial infection caused by Mycobacterium tuberculosis, which mainly attacks the lungs. People who have Tuberculosis will have to go to the hospital and in many cases, the availability of the medical specialist cannot be guaranteed. In most cases, when the medical specialist is available, the patient will not be able to afford the charges of obtaining the hospital form and test conducted. The research work focused on the three stages of Tuberculosis which are Exposure, Latent and Active stages Tuberculosis. Agile methodology method was used to carry out the methodology and the programming tools used in achieving this are HTML JAVASCRIPT, CSS PHP and SQL as the database. These tools were used to develop a medical bot page where users can interact with the system; learn more page where user can get more information about Tuberculosis and Patient Data form page where user can register after diagnosing. The system is made flexible, versatile and user-friendly. The application has been tested by various students using Android devices operating system and successful result was confirmed.

Keywords: *Tuberculosis, Chatbot Development, TB Diagnosis,* Mycobacterium*, Artificial intelligent, Android Application, and Medical Remedies.*

1. Introduction

Tuberculosis is a contagious disease caused by a bacterial infection that spread from one person to another that can be fatal if well treated. People noticing the symptoms of Tuberculosis will have to go to the hospital to meet the specialist which their availability cannot be determined, in most cases, when the medical specialist is available, the patient will not be able to afford the charges involved.

TB most often affects the lungs, but can also affect other organs like brain. However, the microbe may also spread to other body parts, such as the guts, skeleton, brain, and gland, from the lungs via different routes. When an infected TB person sneezes, spits, or coughs, the bacteria are expelled from the body. If inhaled by a healthy person, even in minimal quantities, these bacteria can cause TB. Though our understanding of its causes and treatment began as far back as 1884, multiple challenges continue to persist in eliminating it completely even today TB is an airborne disease that can affect any individual [10].

However, certain risk factors have been identified that make some people more susceptible to infection, such as under nutrition, smoking, alcohol abuse, HIV and diabetes. Overcrowding and poor ventilation increase the chances of TB spreading within a community. Screening methods and diagnostic tests have been developed to detect TB. More so, at the margins of society, access to tools that match the desired level of sensitivity remains a challenge. These challenges, coupled with wide systemic gaps, significantly hamper early detection of TB and identification of those who might be at risk [4].

Olanrewaju, O. T, Ayobioloja, S. P., Azagba, I. P., Adewale, F. O., Chris-Alofe, M. F. and Olayiwola, S. T. (2025). Development of an Android-Based MedicalBot to Diagnose and Suggest Remedies for Tuberculosis. *University of Ibadan Journal of Science and Logics in ICT Research (UIJSLICTR)*, Vol. 15 No. 1, pp. 110 - 120

Tuberculosis cannot be cured or treated without diagnosing. Diagnosis comes from the Greek gnosis, meaning knowledge, is the foundation on which medical treatment is based. It is the act of identifying a disease, condition or injury from its signs and symptoms. Diagnosis is the determination of the nature of the case of a disease; it is based on signs and symptoms and laboratory findings during life. It is also the process of determining the nature of a disease or disorder and distinguishing it from other possible conditions [1].

Recent advances in technology demonstrate how AI can improve TB screening and diagnosis, example is the work of [6] who developed DeepGB-TB, a lightweight convolutional neural network combined with gradient-boosted trees to achieve high diagnostic performance while being optimized for real-time mobile deployment. More so, parallel algorithmic advancement mobile applications are being designed for frontline TB diagnosis and patient support but none of them generalize on many symptoms that can cause TB.

Patients with tuberculosis can be cured, when necessary, precautions are taken; remedies are taken note, and prescribed medicine are used. Therefore, in order to prevent tuberculosis from spreading from one person to another, a medical bot application was developed which can help user to diagnose tuberculosis using its symptoms, display the stages of the TB and suggest treatment for the stage.

2. Related Works

Wardatul, [10] explained that Tuberculosis (TB) is a chronic disease that is still a public health problem globally, including Indonesia, due to its easy and fast transmission. Worldwide, about 10 million people fall ill with tuberculosis (TB) each year.

Lee, *et al*, 5] stated that TB is one of the top 10 causes of death. The main reason is an infectious agent (Mycobacterium Tuberculosis). This TB disease is at the top of the HIV / AIDS ranking in the list of deadly diseases. The condition can affect anyone anywhere, but most people with TB are adults (about 90%). The male and female ratio is 2:1, and the national case rates vary from less than 50 to more than 5,000 per year, one million populations per year. Nearly 90% of cases each year are in 30 high TB countries

Musa [7] examined the treatment for TB sufferers, and concluded that the treatment can be done with several drug combinations that are intended to eradicate germs. He also clarified that for TB sufferers, the key to successful therapy is that the patient must comply with taking medication every day as prescribed by the medical specialist. The lengthy treatment time is usually at least six months, namely category one TB treatment consisting of two phases: an intensive phase for two months and a follow-up phase for four months. This allows for non-adherence to taking the medication by patients with the long duration of the treatment. If not treated properly, there will be a risk of disease complications, such as tuberculosis bacteria resistant to drugs so that TB treatment will be more difficult. Putri [8] stated that Health operators and regulators deploy chatbots solution to allow patients to book appointments, get test results, and find health information in local languages.

Cinderatama [3] stated that Health operators use Medical chatbots to deliver automated patient booking, payment troubleshooting, and pharmaceutical delivery. The solution also provides handling of repetitive consumer support queries across local languages and underserved populations

Asri [2] opined that Medical Chatbots are designed to assist patients and avoid issues that may arise during normal business hours, such as waiting on hold for a long time or scheduling appointments that don't fit into their busy schedules. With 24/7 accessibility, patients have instant access to medical assistance whenever they need it.

Rajvanshi [9] opined that Healthcare chatbots provide information about public health concerns like Tuberculosis, COVID, flu and measles. Indeed, recent years have shown how healthcare chatbots have been used to assist without risking healthcare workers, including;

i. Directing patients with severe symptoms to healthcare facilities with available staff and beds
ii. Providing around-the-clock information about COVID-19 updates and symptoms, and answering FAQs
iii. Scheduling next vaccinations and finding the closest vaccination clinic

iv. Providing mental health assistance to cope with pandemic stress.

3. Methodology

The developed system adopted the Agile Software Development Life Cycle (SDLC) model and is qualitative in nature. This method was chosen because of its ability to phase the features of the application being implemented and also its flexibility to revisit implemented phases for corrections and adjustments to fit future scope. Using this model, the following phases were taken into consideration: Requirement Gathering, System Analysis, System Design, Testing, and Deployment (as shown in Figure. 1).

3.1 Requirement Gathering

a. An investigation was conducted to predict the problems faced by tuberculosis (TB) patients. It was discovered that:
b. Many carriers of the disease do not have prior understanding of the symptoms until it becomes severe.

In most cases, patients mistake the symptoms for other diseases such as malaria or other infectious illnesses.

3.2 System Analysis

The problems of the existing system were analyzed based on the information gathered. It was revealed that patients often face the following challenges in accessing proper TB treatment:

a) Stress – Many patients find visiting hospitals stressful due to long delays before seeing a doctor or medical personnel.
b) Funds – High costs of hospital processes, such as payment for forms and treatments, discourage patients from seeking medical help.
c) Delay in Test Results – Prolonged delays in receiving test results allow tuberculosis to progress from one stage to another, worsening patients' conditions.

3.3 System Design

The system was designed following the Agile model (Figure. 1). The program flowchart (Figure. 2) contains three modules, which are:

a) Home Page Module – Contains all home page elements, including the "Get Started" and "Learn More" links, which direct users to other pages for more information.

b) MedicalBot Page Module – The main module of the program that handles:

i. Data processing, AI, information retrieval, and user communication.
ii. Internet connection for chatbot updates and future improvements.
iii. An AI system built using PHP with neural networks, ensuring accurate, human-like, and timely responses in natural language.

c) Patient Data Module – Responsible for saving and retrieving patient data to and from the database. This data supports the chatbot in generating accurate responses. It was developed using HTML, CSS, and MySQL. The database includes five main tables: Patient Table, Medical Chatbot Table, TB Symptoms Table, TB User's Table and Diagnosis Table. (Tables 1, 2, 3,4 and 5).

3.4 System Testing

System testing was conducted with the participation of students and administrative staff of the Federal College of Animal Production and Technology, Ibadan, in collaboration with the College Medical Center. Issues reported during testing were corrected iteratively until the application met the required standard.

The following tests were carried out:

a) Program Test – Each module was tested after coding and compilation to verify its individual performance.
b) Application Test – After program-level testing, the full android application was tested as a whole to ensure integration and functionality.

3.5 System Deployment

This final phase involved the deployment of the application after all tests had been successfully conducted. At this stage, the application was confirmed fit for use and released for practical implementation.

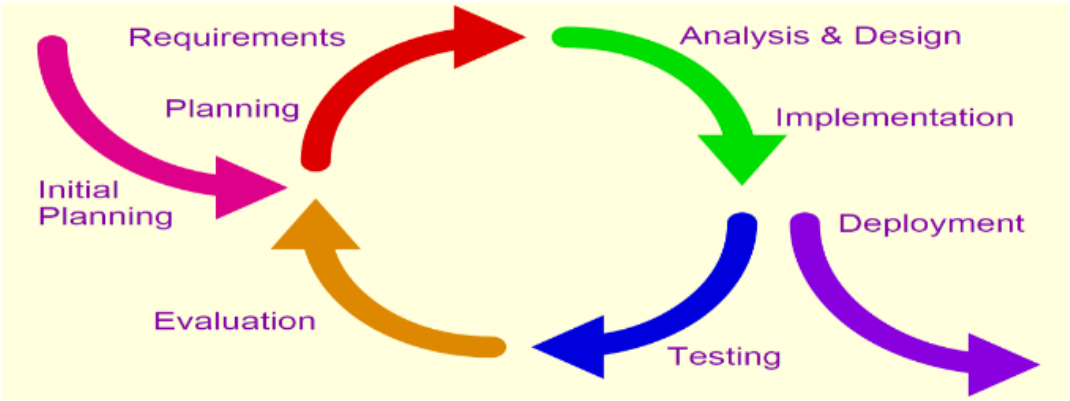

Figure 1: Agile Software Development Model (source: relevant. software)

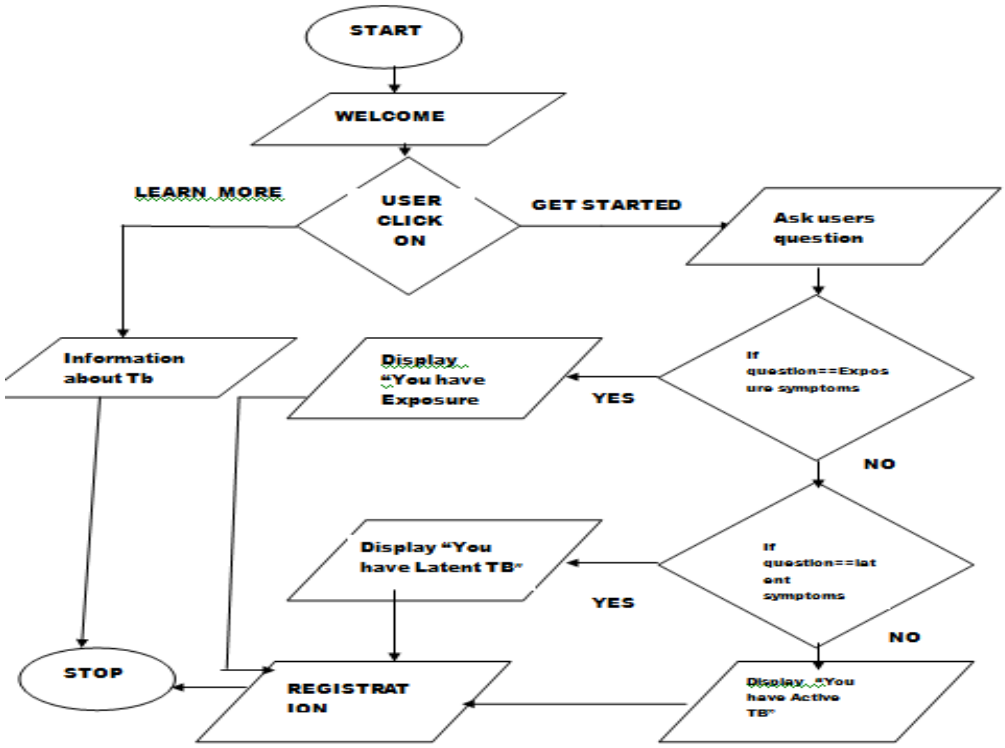

Figure 2: System Flowchart Diagram.

Table 1: Patient Table

Field	Data Type	Description
UserID (PK)	INT	Unique identifier for each user
Name	VARCHAR(100)	User's name (optional for privacy)
Age	INT	User's age
Gender	VARCHAR(10)	Male/Female/Other
Location	VARCHAR(100)	User's city/state
Contact	VARCHAR(50)	Optional (for follow-up)
MedicalHistory	TEXT	Past TB, HIV, smoking, diabetes etc.

Table 2: MedicalBot Table

Field	Data Type	Description
BotID (PK)	INT	Unique record ID
PatientID (FK)	INT	Links to Patient table
RiskLevel	VARCHAR(20)	Low, Medium, High
SuggestedTests	VARCHAR(150)	Chest X-ray, Sputum test, GeneXpert
Remedies	TEXT	Suggested remedies (home care, preventive, clinical advice)
DateDiagnosed	DATETIME	When the bot gave the response

Table 3: TB symptoms Table

Field	Data Type	Description
SymptomID (PK)	INT	Unique identifier
SymptomName	VARCHAR(100)	e.g., Persistent Cough, Chest Pain
Description	TEXT	Details about the symptom

Table 4: TB User's Symptoms Table

Field	Data Type	Description
UserSymptomID (PK)	INT	Unique record ID
UserID (FK)	INT	Linked to User table
SymptomID (FK)	INT	Linked to Symptom table
Severity	VARCHAR(20)	Mild, Moderate, Severe
Duration	VARCHAR(50)	e.g., 2 weeks, 1 month
DateReported	DATETIME	When the symptom was reported

Table 5: Diagnosis Table

Field	Data Type	Description
DiagnosisID (PK)	INT	Unique identifier
UserID (FK)	INT	Linked to User
RiskLevel	VARCHAR(20)	Low, Medium, High
SuggestedTest	VARCHAR(100)	e.g., Chest X-ray, Sputum test
DateDiagnosed	DATETIME	Date of diagnosis

4. Result and Discussion

The developed Android- Based MedicalBot called TB Medical Bot was designed on a computer system, Mobile Phones, Tablet and Computerized devices with hardware specification of an internal storage space (16GB minimum), RAM (2GB minimum) and CPU (1.83GHZ minimum). The software requirement includes an Android Operating System (Version 5.00 or later), TCP / IP protocols, HTML, JAVASCRIPT, CSS, PHP and SQL.

The evaluation of this system was focused on the auto responsive Mobile Application that run on android devices. The developed system diagnoses and predicts the stages of Tuberculosis, suggests remedies for each stage of Tuberculosis, accepts data and gives out relevant result without human intervention. The result is in two phases; input design and output design. The results of the input design are shown from Figure 3 - 6 while the output design results follow from Figure 7-10.

Figure 3 shows the Home page that allows the user to either select an activity on the site or view a guide on how the page works and how to use it. The user makes a choice by simply clicking an action.

Figure 4 displays the Welcome page, this page pop up after clicking get started and it is the interactive page between the user and the medical bot.

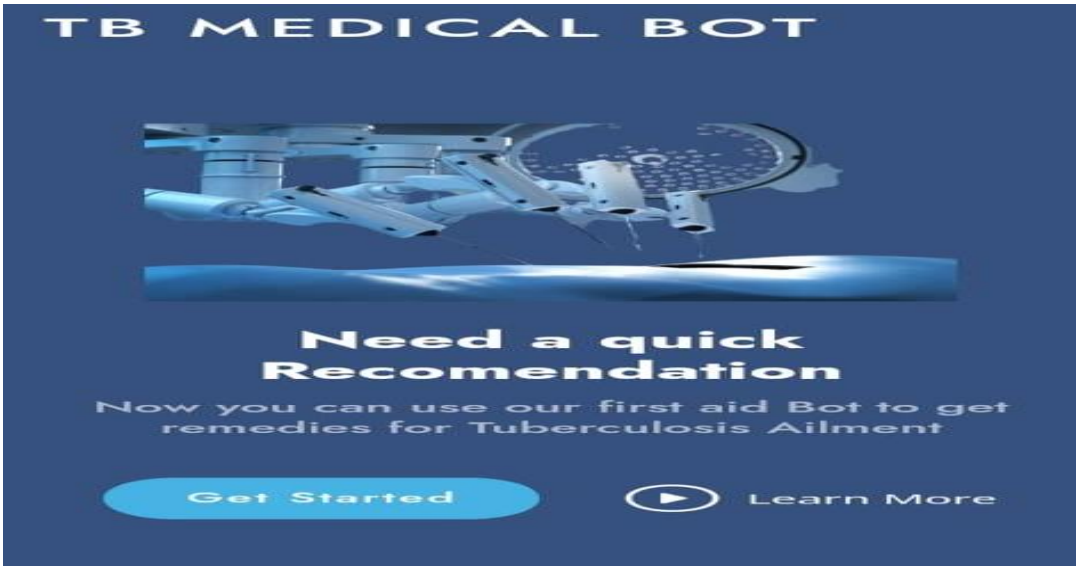

Figure 3: Medical bot Home page.

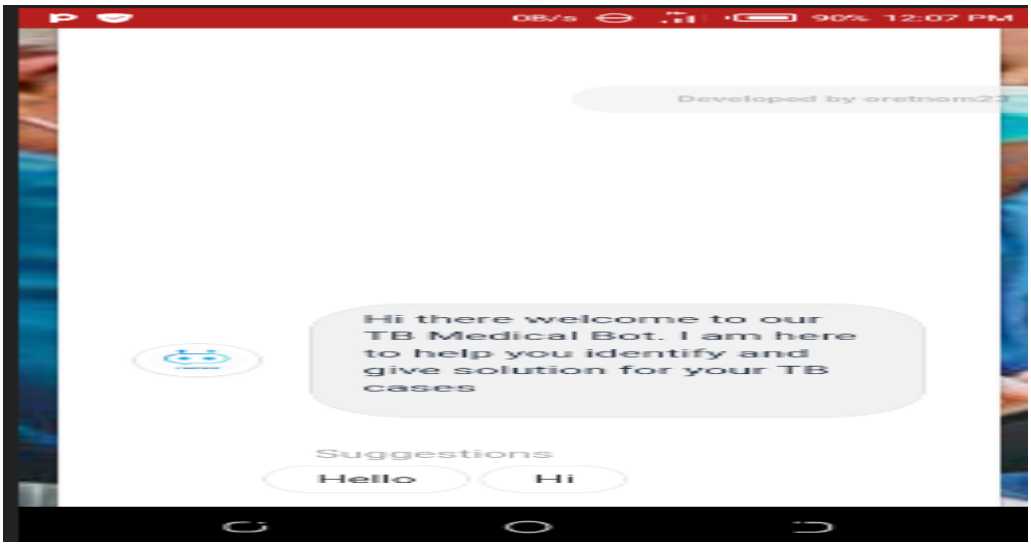

Figure 4: Welcome page

Figure 5 depicts the input page where uses input all necessaries information as requested by the Bot.
Figure 7 explains the user's result at the latent stage and the recommendation

Figure 6 which is the TB Patient's form shows the user's information and it includes the user's Full name, Phone number and Status.

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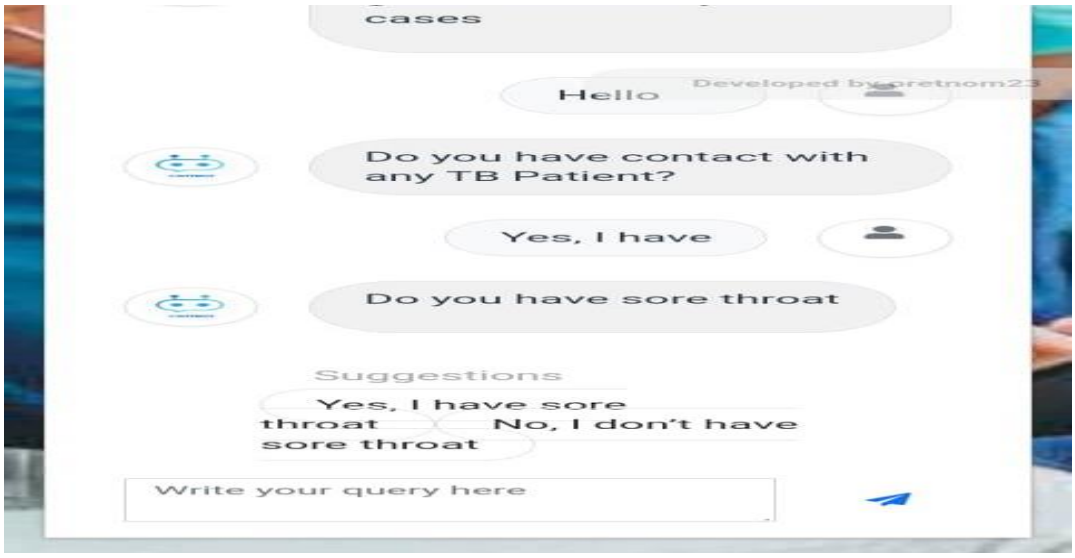

Figure 5: Use's input page

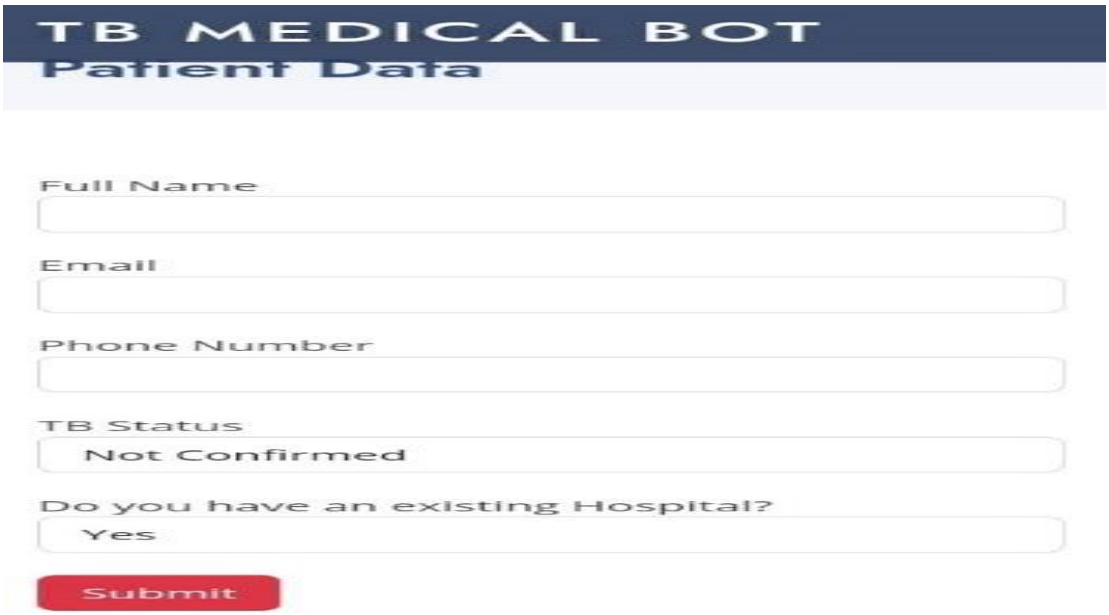

Figure 6: TB Patient's form

Figure 7: Latent TB stage

Result of Patient without TB after several interaction with the medical bot was display in Figure 8

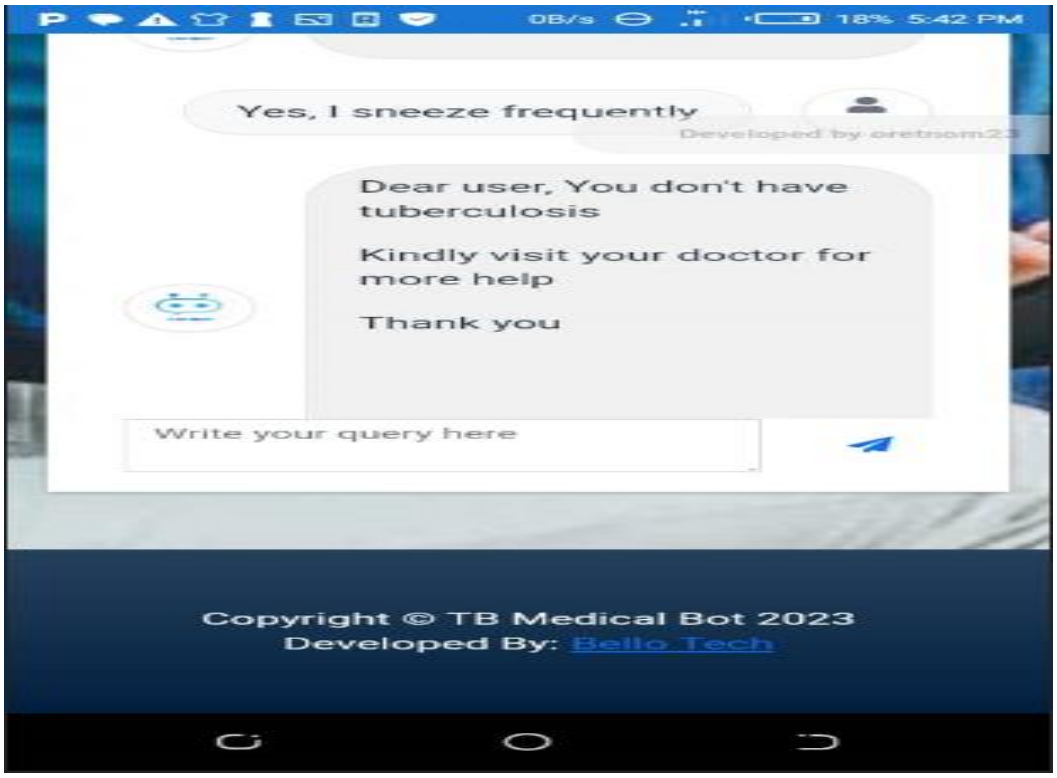

Figure 8: Output of a user without TB

Figure 9 explains the user's result at the exposure stage and the recommendation.

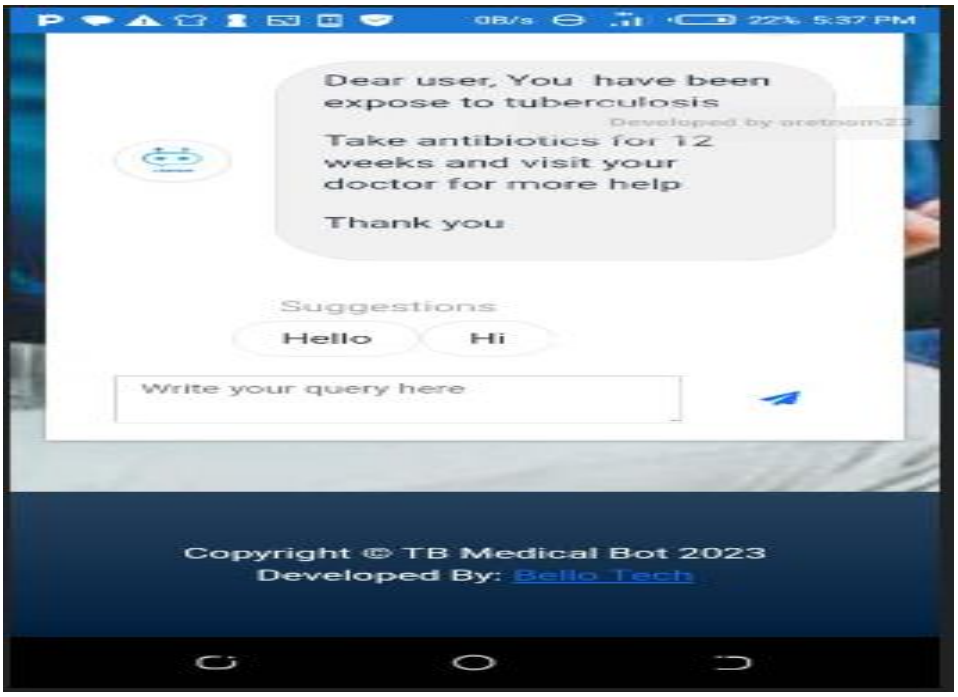

Figure 9: The output of a user with Exposure TB stage

Figure 10 displays the video to learn more about the TB

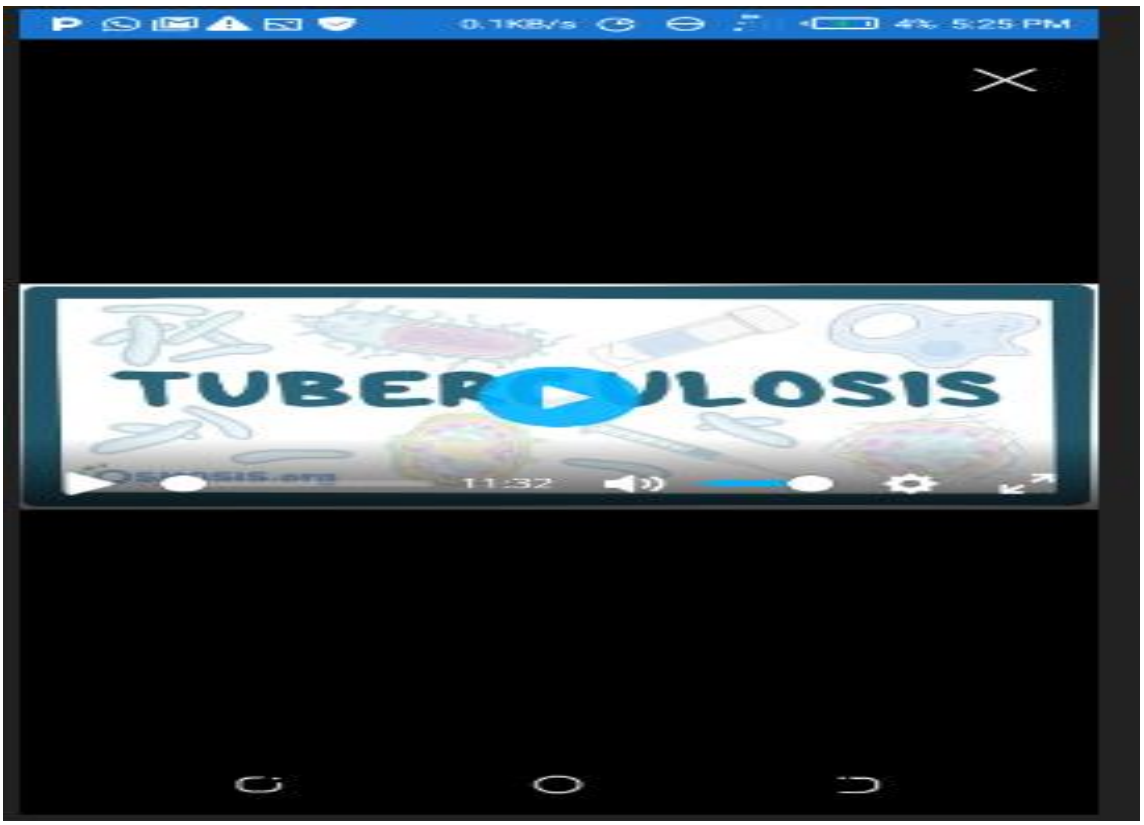

Figure 10: The Learn more page

4.1 Discussion

The research work was developed to display output when users provide their symptoms, it displays any of the three stages of Tuberculosis and suggested treatment for each stage; Exposure stage, Latent stage and Active stage Tuberculosis and also gives room for user to fill a form for record purpose. Features in the developed system include medical bot page where users can interact with the system, learn more page where user can get more information about Tuberculosis and Patient Data form page where user can register after diagnosing. The system is made flexible and versatile. This application has a user-friendly screen application without any inconvenience. The application has been tested by various students and staff of Federal College of Animal Health and Production Technology Moor Plantation Ibadan, that use Android Operating system and has provided a successful result. The developed Medical Bot App is user friendly, easy to use and very efficient.

5. Conclusion

The development of an Android-Based MedicalBot to diagnose and suggest remedies for tuberculosis demonstrates the potential of mobile health technology in bridging the gap between patients and healthcare services. Tuberculosis remains a significant global health challenge, particularly in developing nations where access to early diagnosis and timely treatment is often limited. By leveraging the accessibility of Android devices, the MedicalBot provides an interactive, user-friendly, and cost-effective platform that guides users through symptom assessment, offers possible diagnostic outcomes, and recommends appropriate remedies or steps to seek medical attention.

This system not only improves awareness and self-monitoring among individuals but also reduces the strain on healthcare professionals by filtering cases that require urgent attention. The Agile methodology used in its development ensures that the MedicalBot can be continuously refined, updated, and scaled to address user feedback, new medical guidelines, and broader healthcare needs.

While the MedicalBot is not intended to replace professional medical diagnosis, it serves as an innovative digital assistant that promotes early detection, encourages health-seeking behaviour, and provides educational resources about tuberculosis management. Future improvements could involve integrating artificial intelligence for more accurate predictions, linking the application with healthcare databases for real-time reporting, and expanding its scope to cover other infectious diseases.

Lastly, the Android-Based MedicalBot represents a valuable contribution to digital health innovation. It underscores the role of technology in enhancing disease control, improving patient outcomes, and supporting global efforts in combating tuberculosis.

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