Phase 4 : DEVELOPMENT PART 2

PROJECT TITLE	**IOT SMART WATER SYSTEM**
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GITHUB REPOSITORY LINK	**https://github.com/kirubagaran-v/IBM-NAANMUDHALVAN.git**

IOT SMART WATER MANAGEMENT

Project overview:

In this phase, we will continue building the project by developing a mobile app using Android Studio. The objective is to create an app that displays real-time parking availability data received from an ESP32 microcontroller, utilizing Firebase for data transmission and storage.

Prerequisites:

- Android studio installed
- A firebase account setup for the project
- An ESP32 microcontroller programmed with Micro python
- A basic understanding of python programming

Step 1: Setting Up the Development Environment

Install Android Studio:

- If not already installed, download and install Android Studio from the official website: https://developer.android.com/studio.

Configure Android Studio:

- Ensure you have the necessary SDKs and tools installed for Android app development.

Firebase Setup:

- If not done already, create a Firebase project at https://console.firebase.google.com/ and configure it for your Android app.

Step 2: Designing the App Interface

Implement the UI:

- Use Android Studio's Layout Editor to create the app's user interface.

1. **Open Android Studio:** Launch Android Studio and open your Android app project.
2. **Navigate to XML Layout File:** In the project explorer, navigate to the "res" folder, then "layout," and find the XML layout file where you want to design your user interface. Double-click the XML file to open it.
3. **Open Layout Editor:** Once you've opened the XML layout file, you'll see two tabs at the bottom of the XML editor: "Text" and "Design." Click on the "Design" tab to open the Layout Editor.
4. **Palette:** On the left side of the Layout Editor, you'll find the "Palette" panel.It contains various UI components such as buttons, text views, image views,

and more. You can drag and drop these components onto the layout canvas to build your interface.

5. **Component Tree:** On the right side of the Layout Editor, you'll find the "Component Tree" panel. It displays the hierarchy of UI components on yourlayout. You can select and manipulate components in this panel.
6. **Attributes Panel:** Below the "Component Tree" panel, you'll find the "Attributes" panel. This panel allows you to customize the properties of selected UI components. You can change attributes like text, color, size, andpositioning.
7. **Layout Canvas:** The central area of the Layout Editor is the layout canvas. This is where you visually arrange and design your app's user interface. You can drag and drop components onto the canvas, adjust their positions, and seea real-time preview of how your layout will appear in the app.
8. **Preview:** Above the layout canvas, there's a "Preview" panel that shows a livepreview of how your layout will look on different devices and orientations. You can switch between various screen sizes and orientations to ensure your layout is responsive.
9. **Zoom and Pan:** You can zoom in and out of the layout canvas by using the zoom slider in the bottom right corner. You can also pan around the canvas towork on different parts of your layout.
10. **Design Toolbar:** At the top of the Layout Editor, you'll find the design toolbar. It contains options for adding constraints, aligning components, andcustomizing the layout.
11. **Adding Constraints:** Android Studio uses a constraint-based layout system (Constraint Layout) by default. To position UI components, you can add constraints that specify how they relate to other components or the parent layout. Constraints help your layout adapt to different screen sizes.

12. **Preview Your Layout:** As you design your user interface, use the "Preview" panel to see how your layout will appear on different devices and orientations.Make adjustments as needed to ensure a responsive design.

13. **Save Your Layout:** Don't forget to save your layout by clicking the "Save"button in the top-left corner.

14. **XML Code View:** If you need to make fine-grained adjustments or add complex attributes, you can switch to the "Text" tab to edit the XML codedirectly.

Layout program:

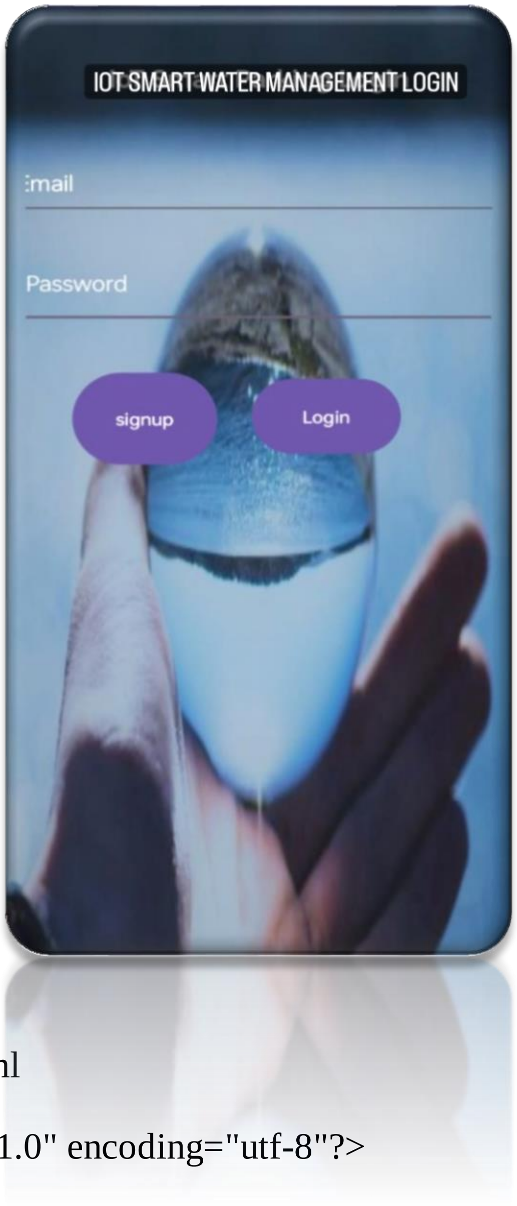
Activity_main.xml

```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="@drawable/image21"
    android:padding="16dp"
    tools:ignore="ExtraText">
```

```
<EditText
    android:id="@+id/emailEditText"
    android:layout_width="349dp"
    android:layout_height="54dp"
    android:hint="Email"
    android:inputType="textEmailAddress"
    android:textColor="#FAFAFA"
    android:textColorHint="#FFFFFF"
    app:layout_constraintBottom_toTopOf="@+id/passwordEditText"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toTopOf="parent"
    app:layout_constraintVertical_bias="0.865" />

<EditText
    android:id="@+id/passwordEditText"
    android:layout_width="335dp"
    android:layout_height="67dp"
    android:hint="Password"
    android:inputType="textPassword"
```

```
        android:textColor="#F1EEEE"

        android:textColorHighlight="#F8F5F5"

        android:textColorHint="#F3F0F0"

        app:layout_constraintBottom_toBottomOf="parent"

        app:layout_constraintEnd_toEndOf="parent"

        app:layout_constraintHorizontal_bias="0.592"

        app:layout_constraintStart_toStartOf="parent"

        app:layout_constraintTop_toTopOf="parent"

        app:layout_constraintVertical_bias="0.257" />


    <Button

        android:id="@+id/loginButton"

        android:layout_width="105dp"

        android:layout_height="64dp"

        android:layout_marginEnd="64dp"

        android:text="Login"

        android:textColorHighlight="#CD7C7C"

        app:layout_constraintBottom_toBottomOf="parent"

        app:layout_constraintEnd_toEndOf="parent"

        app:layout_constraintTop_toTopOf="parent"

        app:layout_constraintVertical_bias="0.419"
    app:rippleColor="#E14545"
    app:strokeColor="#E85656" />

<Button
    android:id="@+id/signup"
    android:layout_width="102dp"
    android:layout_height="77dp"
    android:layout_marginEnd="24dp"
    android:text="signup"
    android:textColorHighlight="#DC4040"
    android:textColorLink="#D84577"
    app:layout_constraintBottom_toBottomOf="parent"
    app:layout_constraintEnd_toStartOf="@+id/loginButton"
    app:layout_constraintTop_toTopOf="parent"
    app:layout_constraintVertical_bias="0.42" />

<TextView
    android:id="@+id/textView"
    android:layout_width="251dp"
    android:layout_height="36dp"
    android:layout_marginBottom="24dp"
```

```
        android:fontFamily="sans-serif-black"
        android:text="IoT Smart water management"
        android:textAlignment="center"
        android:textColor="#F8F5F5"
        android:textColorHighlight="#FAF9F9"
        android:textColorHint="#FFFFFF"
        android:textColorLink="#FBF9F9"
        android:textSize="20sp"
        android:textStyle="bold"
        app:layout_constraintBottom_toTopOf="@+id/emailEditText"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.506"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintVertical_bias="0.859" />

</androidx.constraintlayout.widget.ConstraintLayout>
```

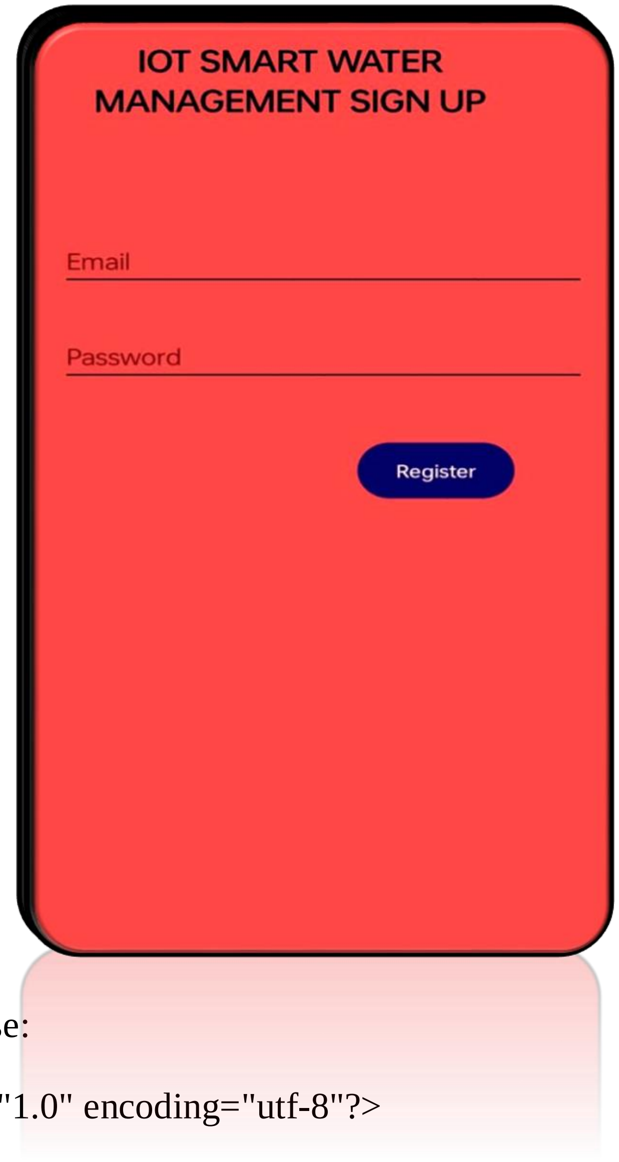


Activity_login.xml

```
 <?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"
    xmlns:tools="http://schemas.android.com/tools"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#FF9191"
```

```
android:padding="16dp">

<EditText
    android:id="@+id/emailEditText"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:hint="Email"
    android:inputType="textEmailAddress"
    app:layout_constraintBottom_toTopOf="@+id/passwordEditText"
    app:layout_constraintTop_toTopOf="parent"
    app:layout_constraintVertical_bias="0.844"
    tools:layout_editor_absoluteX="16dp" />

<EditText
    android:id="@+id/passwordEditText"
    android:layout_width="match_parent"
    android:layout_height="wrap_content"
    android:layout_marginBottom="436dp"
    android:hint="Password"
    android:inputType="textPassword"
    app:layout_constraintBottom_toBottomOf="parent"
    tools:layout_editor_absoluteX="16dp" />


<Button
    android:id="@+id/registerButton"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:text="Register"
    app:layout_constraintBottom_toBottomOf="parent"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintHorizontal_bias="0.803"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toBottomOf="@+id/passwordEditText"
    app:layout_constraintVertical_bias="0.094" />


<TextView
    android:id="@+id/textView2"
    android:layout_width="286dp"
    android:layout_height="69dp"
    android:text="IoT Smart water management Sign Up"
    android:textAlignment="center"
    android:textAllCaps="true"
```

```
        android:textSize="24sp"
        android:textStyle="bold"
        tools:layout_editor_absoluteX="48dp"
        tools:layout_editor_absoluteY="39dp" />

</androidx.constraintlayout.widget.ConstraintLayout>
```



Activity_firebase:

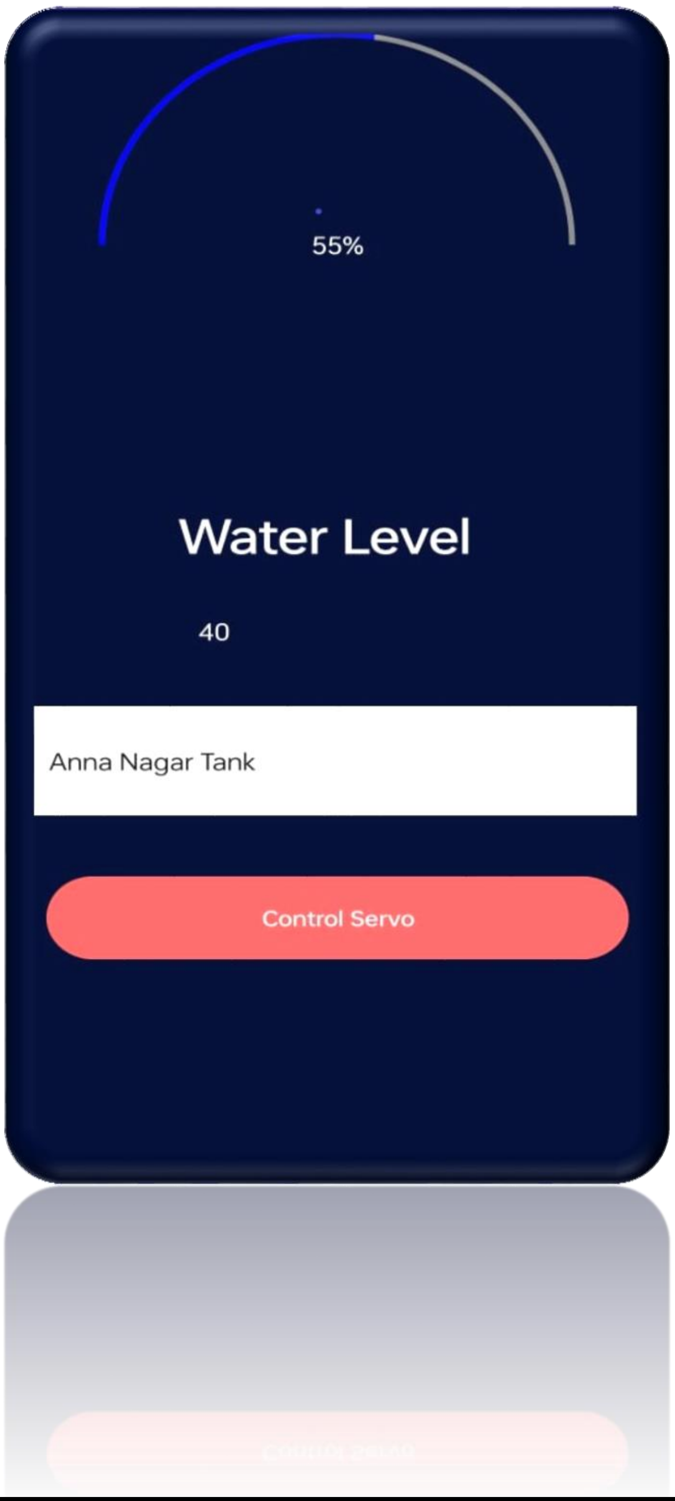
```
<?xml version="1.0" encoding="utf-8"?>
<androidx.constraintlayout.widget.ConstraintLayout
```

```
xmlns:android="http://schemas.android.com/apk/res/android"
    xmlns:app="http://schemas.android.com/apk/res-auto"

    xmlns:tools="http://schemas.android.com/tools"

    android:id="@+id/relativeLayout"
    android:layout_width="match_parent"
    android:layout_height="match_parent"
    android:background="#000C33"
    tools:context=".MainActivity">

    <!-- Custom Meter Gauge -->



    <com.example.smartwatermanagement.GaugeView

        android:id="@+id/gaugeView"
        android:layout_width="328dp"
        android:layout_height="254dp"
        android:layout_centerInParent="true"
        android:rotation="0"
        android:rotationY="0"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.493"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintVertical_bias="0.033" />

    <TextView
        android:id="@+id/waterFlowTextView"
        android:layout_width="150dp"
        android:layout_height="32dp"
        android:text="Water Flow: 0 L/min"
        android:textColor="#FFFFFF"
        android:textSize="16sp"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.498"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintVertical_bias="0.533" />
```

```
<Spinner
    android:id="@+id/locationSpinner"
    android:layout_width="326dp"
    android:layout_height="66dp"
    android:background="#FDFDFD"
    android:backgroundTint="#FFFFFF"
    android:entries="@array/location_entries"
    app:layout_constraintBottom_toBottomOf="parent"
    app:layout_constraintEnd_toEndOf="parent"
    app:layout_constraintHorizontal_bias="0.471"
    app:layout_constraintStart_toStartOf="parent"
    app:layout_constraintTop_toTopOf="parent"
    app:layout_constraintVertical_bias="0.645" />

<Button
    android:id="@+id/controlButton"
    android:layout_width="315dp"
    android:layout_height="58dp"
    android:backgroundTint="#FB6565"
    android:text="Control Servo"
```

```
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintVertical_bias="0.787" />

    <TextView
        android:id="@+id/textView4"
        android:layout_width="243dp"
        android:layout_height="39dp"
        android:text="Water Level"
        android:textAlignment="center"
        android:textColor="#FDFDFD"
        android:textSize="32sp"
        android:textStyle="bold"
        app:layout_constraintBottom_toBottomOf="parent"
        app:layout_constraintEnd_toEndOf="parent"
        app:layout_constraintHorizontal_bias="0.44"
        app:layout_constraintStart_toStartOf="parent"
        app:layout_constraintTop_toTopOf="parent"
        app:layout_constraintVertical_bias="0.439" />
```

```
</androidx.constraintlayout.widget.ConstraintLayout>
```


55%
Water Level
40
Anna Nagar Tank
Control Servo

Firebase.java

```
package com.example.smartwatermanagement;


import android.os.Bundle;
import android.view.View;
import android.widget.AdapterView;
import android.widget.ArrayAdapter;
import android.widget.Spinner;
import android.widget.TextView;
import android.widget.Toast;


import androidx.annotation.NonNull;
import androidx.appcompat.app.AppCompatActivity;


import com.google.firebase.database.DataSnapshot;
import com.google.firebase.database.DatabaseError;
import com.google.firebase.database.DatabaseReference;
import com.google.firebase.database.FirebaseDatabase;
import com.google.firebase.database.ValueEventListener;

public class Firebase extends AppCompatActivity {
    private GaugeView distanceGauge;
    private TextView humidityGauge;
    private Spinner locationSpinner;
    private DatabaseReference sensorDataRef;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_firebase);

        locationSpinner = findViewById(R.id.locationSpinner);

        // Initialize Firebase
        FirebaseDatabase firebaseDatabase = FirebaseDatabase.getInstance();

        // Set up initial DatabaseReference based on the default spinner selection
        updateSensorDataRef(locationSpinner.getSelectedItemPosition(),
firebaseDatabase);

        // Get references to GaugeView widgets in your layout
        distanceGauge = findViewById(R.id.gaugeView);
        humidityGauge = findViewById(R.id.waterFlowTextView);
        // Set up a listener to retrieve data from Firebase based on the selected sensor
        sensorDataRef.addValueEventListener(new ValueEventListener() {
            @Override
            public void onDataChange(@NonNull DataSnapshot dataSnapshot) {
                if (dataSnapshot.exists()) {
                    // Retrieve values from the dataSnapshot
                    DataSnapshot waterLevelSnapshot =
dataSnapshot.child("WaterLevel");

                    if (waterLevelSnapshot.exists()) {
                        Integer distance = waterLevelSnapshot.getValue(Integer.class);

                        if (distance != null) {
                            int distanceValue = distance;
                            // Now you can safely use distanceValue
                            distanceGauge.setValue(distanceValue);
                            humidityGauge.setText("40"); // Assuming you want to set a
string, not an integer
                            Toast.makeText(Firebase.this, "Waterlevel: " + distanceValue,
Toast.LENGTH_SHORT).show();
                        } else {
                            Toast.makeText(Firebase.this, "WaterLevel itself exists but is
null", Toast.LENGTH_SHORT).show();
                        }
                    } else {
                        // Handle the case where "WaterLevel" does not exist in the
dataSnapshot
                        Toast.makeText(Firebase.this, "WaterLevel itself doesn't exist",
Toast.LENGTH_SHORT).show();
                    }
                } else {
                    // Handle the case where the dataSnapshot itself doesn't exist
                    Toast.makeText(Firebase.this, "dataSnapshot itself doesn't exist",
Toast.LENGTH_SHORT).show();
                }
            }

            @Override
            public void onCancelled(DatabaseError databaseError) {
                // Handle database error
            }
        });

        // Add a listener to the spinner to change the selected sensor
        locationSpinner.setOnItemSelectedListener(new
AdapterView.OnItemSelectedListener() {
            @Override
```

```
            public void onItemSelected(AdapterView<?> parentView, View
selectedItemView, int position, long id) {
                // When the spinner selection changes, update the DatabaseReference
                updateSensorDataRef(position, firebaseDatabase);
            }

            @Override
            public void onNothingSelected(AdapterView<?> parentView) {
                // Do nothing
            }
        });
    }

    // Method to update the DatabaseReference based on spinner selection
    private void updateSensorDataRef(int selectedSensor, FirebaseDatabase
firebaseDatabase) {
        if (selectedSensor == 0) {
            sensorDataRef = firebaseDatabase.getReference("sensor_0");
        } else if (selectedSensor == 1) {
            sensorDataRef = firebaseDatabase.getReference("sensor_1");
        }
    }
}
```

Program Description:

Overview of what the code does:

1. **Imports**: The necessary libraries are imported, including Firebase and Android UI components.
2. **Class Definition**: The class **Firebase** extends **AppCompatActivity**, indicating that it represents an Android activity.
3. **Member Variables**:
   - **distanceGauge**, **humidityGauge**, **locationSpinner**: These are references to UI elements (GaugeView, TextView, and Spinner) in the layout XML file.
   - **sensorDataRef**: This is a reference to the Firebase database.
4. **onCreate Method**:
   - This is called when the activity is created.
   - It sets the content view to the layout defined in **activity_firebase.xml**.
   - It initializes the member variables and gets references to UI elements.
   - It sets up the initial DatabaseReference based on the default spinner selection.
   - It sets up listeners for the sensor data updates and spinner item selections.
5. **updateSensorDataRef Method**:

- This method takes an integer **selectedSensor** and a **FirebaseDatabase** instance as arguments.
- Depending on the value of **selectedSensor**, it updates the **sensorDataRef** with the appropriate reference from the Firebase database.

6. **onDataChange Method**:
   - This method is a callback that is triggered whenever data in the Firebase database changes.
   - It retrieves the water level data from the database and updates the UI elements (distanceGauge and humidityGauge) accordingly.
7. **onCancelled Method**:
   - This method is a callback that is triggered if there's an error when trying to read from the database.
8. **onItemSelected Method**:
   - This method is a callback that is triggered when an item in the spinner is selected.
   - It calls **updateSensorDataRef** to update the DatabaseReference based on the selected sensor.

This Android application is designed for smart water management. It integrates with Firebase, a real-time database service, to retrieve sensor data. The app provides a user interface to view water level information from different sensors.

Key Features:

1. **Firebase Integration:**
    - The app leverages Firebase, a cloud-based platform, for real-time database functionality.
    - It establishes a connection to Firebase to retrieve sensor data.
2. **User Interface:**
    - The app's UI includes elements like Spinner, GaugeView, and TextView to display sensor data.
    - The Spinner allows the user to select different sensor locations.
3. **Sensor Data Display:**
    - The GaugeView visually represents water level data, providing an intuitive display for the user.
    - The TextView shows additional information, such as humidity or flow data.
4. **Dynamic Data Retrieval:**
    - The app dynamically updates sensor data based on the user's selection in the Spinner.
    - It listens for changes in the Firebase database and updates the UI accordingly.
5. **Error Handling:**
    - The app incorporates error handling, including cases where data may be missing or null.

Workflow:

1. **App Initialization:**
    - Upon launching, the app sets up the initial UI components and establishes a connection to Firebase.
2. **Sensor Selection:**
    - The Spinner allows the user to choose a specific sensor location.
3. **Firebase Data Retrieval:**
    - The app listens for changes in the selected sensor's data within Firebase.
4. **Data Update:**
    - When sensor data changes, the app retrieves the new values and updates the UI elements.
5. **Error Handling:**
    - The app handles potential errors, providing user-friendly toast messages to indicate any issues.

Usage Scenario:

- An end-user, such as a water management professional, opens the app on their Android device.
- They select a specific sensor location from the Spinner.
- The app fetches real-time water level data from Firebase and displays it using the GaugeView and TextView.
- If there are any issues with data retrieval, the app notifies the user with a toast message.

Potential Extensions:

- The app's functionality could be expanded to include additional sensors or parameters.
- It could incorporate features like historical data tracking, notifications, or user authentication for enhanced functionality.

Conclusion:

In this paper, a prototype water monitoring system using IOT is presented. For this some sensors are used. The collected data from the all the sensors are used for analysis purpose for better solution of water problems. The data is sends to the cloud server via Wi-Fi module ESP8266. So this application will be the best challenger in real time monitoring & control system and use to solve all the water related problems.