Machine Monitoring System using IoT

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Abstract- This paper is to create a Cloud System to control machines using Android Application and Raspberry Pi. Conventional method requires manual monitoring and human efforts to make adjustments in controlling a machine. Recording of data and checking past history of machine's performance is a big issue in conventional method. Raspberry Pi, a single board computer(System on a chip SoC) which can be effectively used for multiple functions. This paper presents one of the ways of using raspberry Pi for multiple purposes. Here user will operate his application and give commands, and application sends the data to the server. Functions on the online database triggers and makes the required changes in the state of device. Now server again sends the data to the Raspberry Pi and Pi in turn changes the state of the device using that data. Here the state of the device is shown using led's on & off switching. Raspberry Pi controls the machine using the input i.e. online data. It provides user the flexibility to configure almost any type of machine with it, so that machine can easily be operated using an Android Application. It helps in continuously monitoring of the machine. In addition to this, it is used for detecting the breakdown conditions and gives report to the users. This work is monitoring a machine by giving commands using mobile application. When the user switch on the ALL ON button in the app, the corresponding action is performed and all three leds turn from off condition to on.

Keywords—Raspberry Pi, led, online database, Android Application

1. INTRODUCTION

Traditional method of monitoring machines in India and most part of the world is handling them manually. Manual care requires human efforts. For heavy, bulky and multitasking machines, industries hire huge amount of workforce that operate over them and takes proper care about the maintenance and statistics of the machines. This method comes with large amount of flaws and drawbacks due to human error possibility which is very frequent in many of the industries.

To save companies and industries from big losses and to detect the minutest error in the machines, proper monitoring of the machines is very important and this can be done by controlling them digitally i.e. by using android applications. This project have controlled the working of the led by monitoring them using Raspberry Pi and Android Application. Google Firebase is used for online and real time tracking as well as monitoring of the machines. It is used to send the push notifications to the user's machine monitoring application, thereby updating the user with the real time conditions of the machine [1-2].

Raspberry Pi is used, a mini computer that helps in continuous monitoring of devices as well as make necessary changes in its state by allowing the user to operate their machines using an Android application [3-4]. This service becomes more powerful with the use of Google Firebase where server sends the app data to the Raspberry Pi and Pi in-turn controls the state of the device corresponding to the desired input.

2. EXISTING SYSTEMS

R. Piyare et al. discussed existing system of controlling machines include physical labor, where an employee is given the duty to operate the machine manually. This method sometimes requires larger number of employee to control machine. [5]

Other methods include controlling devices using remotes through IR. In this technology, IR is transmitted from one end which is received at the other end, and then the machine starts its working depending upon the given input by the remote.

Controlling machines manually requires physical labor, where the possibility of human error is very high. Most of the time the real-time condition of the device cannot of suitably identified which results in the breakdown of the machine. The possibilities of major losses like fatal accidents which are also very high.

IR has its own limitations. They can transmit radiations to certain range and become inefficient after that. They require user and the device to be at the same place and not letting the customers to access their machines from other places of the world.

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3. METHODOLOGY

The whole Architecture of machine monitoring system is based on the Three Tier System. Basically whole system is divided into three tiers i.e. the Hardware, Script and the User Interface Part.

The approach used to build the hardware setup is nothing but the simple interfacing of the Raspberry Pi 3B with the LEDs.

The approach used to build the User Interface is the Android App Development Platform API Level: 22, so as to support the 90 percent of the Android users currently.

The approach for the Script is the use of Java and Python. Here, python is used in the raspberry Pi for the interfacing of the raspberry Pi with the Firebase by using inbuilt Libraries. Java was used with the Android Application for connecting the Application with the Firebase network.

A. *Stages of Development*
As described earlier, the whole architecture has three tiers i.e. The Hardware, Software and the Scripts.
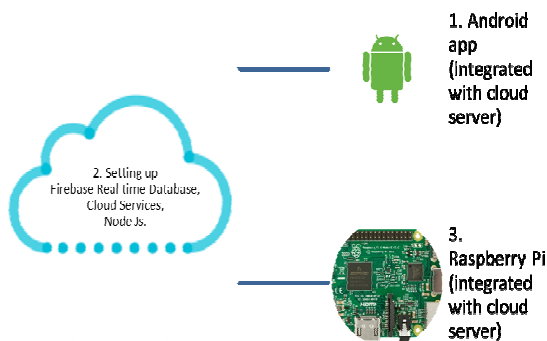 *1) Setting up the Raspberry Pi 3B*

Fig 1: Flow diagram of System

Raspberry Pi 3B comes with the on board Wi-Fi module which brings an ease of connecting the Raspberry Pi with the Internet. Raspberry Pi supports multiple programming languages along with Python, Java & C. Here, python is used as programming language. In order to run any program on the Raspberry Pi it is mandatory to get a working environment i.e. the Operating System for Raspberry Pi which includes Raspberry Pi provided OS such as Raspbian and NOOBS and also some third party OS are also available [6-8]. Here, Raspbian is used as the Operating System.

  2) Setting up the LEDs
LED interfacing was done with the Raspberry Pi on a bread board according to the Python script. As there is a high output flow of charge from the Raspberry Pi so, resistors are must for interfacing.

  3) Setting up Firebase

Firebase serves to be the Database of the system and also as the Server to this project. Firebase is the back bones of this work as it the medium which connects the User Interface to the Raspberry Pi. Firebase comes with a bunch of features such as: Authentication, Real time Database, Storage, Functions, Test lab, Cloud Messaging & Remote Configuration. Here, all these features of the Firebase are used. The main advantage comes with the Firebase is the cost. It provides around 15GB of data storage space completely free of cost. High performing real time database is also a very important feature of Firebase.

For setting up firebase, it requires Google Account, the Application Project Id and the highly secure SHA key for the security purpose.

  4) Android Application
Here, android studio is used as the development platform of the Android Apps. Android studio supports two programming languages Kotlin and Java [9]. Here, Java is used as the programming language to build up the application [10].

In order to complete the interfacing of the Android application with the firebase there are some predefined steps to be followed for this. This includes including the downloaded Google services JSON file, including the Firebase external libraries and then creation of objects of the required firebase class for using the required service [11-12] .

B. *Architecture design of Machine Monitoring System*
  • Raspbian Operating system installation and setting up the python IDE for running program.
  • Writing a Python script for the Rapsberry Pi in order to interface the LEDs along with the Raspberry Pi.
  • Interfacing of the Firebase along with the help of the external libraries i.e Pyrebase.
  • Interfacing of the LED with Raspberry Pi.

Fig 2: Flow chart of System

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- Android Application development
- Writing algorithm for the implementation of task
- Writing up the script for Android application in Java.
- Executing the code.

C. Hardware and Software

1) Raspberry Pi 3B:

It is a high performance CPU (Central Processing Unit) credit card sized unit. Raspberry Pi 3B comes with the on board Wi-Fi module which brings an ease of connecting the Raspberry Pi with the Internet. It has a 1.4 GHz 64-bit quad core processor, dual band Wireless LAN, Bluetooth 4.2/BLE, faster Ethernet and Power over Ethernet support[7].

2) Raspbian Operating System:

It is a Debian-based computer operating system for the Raspberry Pi. There are several versions of Raspbian including the Raspbian Strech. The main reason for the preference to Raspbian over the NOOBS is the more user friendly operating system and the more extend on including the external libraries which is very important for the purpose of development[7].

3) Light Emitting Diodes:

Light Emitting Diodes are the most widely used semi - conductor diodes among all the different types of semi-conductor diodes available. Resistance is a must to protect the LED from the high output charge of Raspberry Pi.

4) Android Studio:

Platform for Android Application Development is created by IntelliJ. It supports Java, kotlin & XML as programming language [10]. The system is completely based on Linux Operating System.

5) Java:

Programming Language used in Android Application development [9] and the also used for interfacing the application with the Firebase Services.

6) Python:

Scripting language python is used for the base program of the Raspberry Pi and the interfacing of the Raspberry Pi with the Firebase using Pyrebase external library.

7) Firebase:

It is used as the server to the system which is common to both the android application and the Raspberry Pi and stores the log and commands for the Raspberry Pi from Android application.

The main feature of Firebase used here is Real Time Database, which is read by the Raspberry Pi program about the new commands received. This database is a No-SQL database and hence, the data gets stored in the form of Key-Value pairs.

4. OPERATION OF THE SYSTEM

The operation process of the system involves the following steps:

- Changing the status of the LED from the user application i.e. sending command from the application.
- The recent or the last command gets transferred to the Firebase and is stored in the Firebase No-SQL Real Time Database.
- The python script which is implementing all the listeners required to interface the Firebase to Raspberry Pi from the pyrebase library, gets notified on the update of the Database values.
- The python script reads the new updated value of the status i.e. ON for HIGH and OFF for LOW.
- As per the new data set of key – value pair received by the python program the raspberry Pi digital Pin outputs are changed,
- Hence, the complete execution of the command sent by the user takes place in this manner each time.

5. CONCLUSION

This paper provides an in-depth discussion on the Raspberry Pi, Google Firebase, Google Cloud Platform, Android Studio IDE, Java and LEDs. From above discussion following can be concluded:

- Using the method of machine monitoring one can save a considerable amount of time.
- Can prevent excessive human efforts.
- Can control big and heavy machines by using an Android Application.
- Real time updates of machines on various department websites.
- Very good solution for Home Automation Technologies where almost all appliances can be monitored and controlled using mobile application.
- Controlling more than one machine using single android application.

This paper presents the urgency of this new method and this method can be adopted as soon as possible so that the limitations experienced with present method can be overcome.

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