

Integrating novel state of the art techniques into generic Personal Assistants with Home Assistant functionality

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Abstract – Software Personal Assistants (PA) have become the trademark of organizations which are involved in developing services that serve the digital needs of the public. Their aim through this trend is to integrate their core technologies into a single point of access in a user customized fashion using prediction mechanisms. Excluding circumstances where data has to be fetched or stored in online sources, most of the PAs existing in the market have a very local reach in its line of services. To enhance the reach of these services, we wish to integrate the functionalities of a Home Assistant (HA) to our PA such that users have the provision of controlling and monitoring devices in their homes amidst carrying out other PA functions in the Android Mobile Platform. The uniqueness in our PA lies in the usage of a Timestamp based Cipher primarily in the Chat Module and in other Modules that comprise of Cloud storage within our PA. Further, we introduce a novel HA Technology, that comprises of an Arduino and an ESP8266-01 Module, which performs the tasks necessary to provide the ambiance of a Smart Home. This Technology has the least investment necessary to set up the same up to date due to the simplicity of the hardware involved. The Smart Home will be powered by Internet of Things (IoT) which allows for the storage, retrieval and monitoring of data through the PA where the data corresponds to the states of the Smart Home at specific points of time.

Keywords – Personal Assistant, Home Assistant, Android, Timestamp based Cipher, Arduino, ESP8266-01, Smart Home, Internet of Things

I. INTRODUCTION

With the evolution of handheld devices and the subsequent development of large number of online services in various sectors of the world, nothing would be more significant than the delivery of many such integral services from a Single Point of Access (SPoA). It is with this intent that Organizations across the world, especially those that specialize in delivering services to the public with expertise, come up with Software Personal Assistants (PA). A PA is a piece of Software that assists Users by providing services that they need either by doing so on their own or by redirecting them to providers of the same thereby achieving the heightened task of making themselves an SPoA. The advantages of a PA serving as a SPoA include:

- Reduced space consumption in the device from which the services are being accessed as there is very often a delivery of basic functionalities of many services instead of complex functionalities of the same, which may prove unnecessary on most occasions
- User customization in the delivery of not just one service, as is provided by most of these services, but also the combination of such services such that two or

more service's functionalities are clubbed together while assisting the completion of User's needs in a much more broad manner

- Doesn't serve solely as a service provider rather as a user-friendly application which can assist the User to complete their daily tasks

PAs have a very wide scope of application unlike initially understood as they have a very important role wherever the clients need deliverance of a set of customized and personal services without much of publicity unlike in Social Media services.

For example, PAs were not widely involved in the healthcare arena during the former's origin. It is only recently that they have played a significant role in the same [1] [2] [6] and are expected to do so in the future especially due to the large prospects of healthcare services that are going to be provided in a personal perspective to Users across the world.

Though there are PAs that are customized to fit into specific sectors of the world, our aim here will be to develop a generic PA that assists daily Users to carry out their tasks

with the assistance of our software. By using our software, they will not have to depend on any other source for services unless the services that they need are very specific and built by dedicated Organizations.

We also wish to introduce a Timestamp based Cipher which we will primarily use in our Chat Module and further extend it to other Modules where there is data access, storage and retrieval from our Server. The main purpose of this Cipher will be to provide security to the data without the use of external data, which would have added to the storage needs, such that all the existing data that is generally used in Chat Modules are integrated to ensure security of data.

Further, it is very rare for PAs to be integrated with Home Assistants (HA) and even if they exist, it often involves a high investment rate at the initial stages due to the replacement of existing devices with smart devices. Here, we will be introducing the most cost-effective HA technology up to date, which utilizes the simplest hardware that the Market possesses. This will be brought into place in order to not burden the Users with an investment for the devices, as there is no replacement of devices, but rather introduce a piece of technology to the existing system which will produce a Smart Home Environment on its own.

Among the other Modules of the PA another novelty lies in the ability of our Software to do a set of Social Media Tasks that enable the User to share data to Social Media Applications directly without the need to access the latter. Though sending mails is an existing ability in many PAs, there are not many that can share data on Social Media like Facebook and Twitter, which is what we wish to achieve with the help of the latter's APIs and tools.

In Section II, we will be discussing how other authors across the globe have gone about implementing their PAs in various sectors especially in the healthcare arena. Since our System comprises of the integration of two ideas, i.e. a PA and a HA where the former is purely software oriented and the latter integrates the application of software into hardware components, Sections III and IV will describe the two respectively though the latter is only a single module of the former. As a summary, Section V will deliver the gist of what we have been able to achieve so far and what we wish to achieve and integrate to our PA in the future.

II. RELATED WORK

A PA is not a novel idea, though it has to be noted that what this PA can do has the capability of being novel, complex and broad in nature. In this regard, we surveyed the following literature works that gave us an idea as to how vast the scope of PAs can be in order to ensure that our PA is novel in its application and has the potential to provide services to a large part of the population.

In [1], the authors propose a novel IoT-based mobile gateway solution for mobile health scenarios. The gateway that they have developed collects user's health information and correspondingly performs a set of actions as defined in their algorithm.

The authors of [2] discuss the use of images and emotional representations of patients and elderly people in order to diagnose and treat them as their research suggests that such emotional detections can provide a much more effective treatment and that it has not been widely utilized.

In [3], [4], [5], [7] and [8], mechanisms that assist Users in their daily actions through intelligent techniques and personal assistants have been described and an interesting yet expected correlation is the provision of an IoT and Smart Home Environment.

In [6] however, the authors have utilized the IoT environment to remind and monitor the consumption of medicines by patients to ensure that the Users are benefitted by the timely intervention of the software in their health cycle.

III. PERSONAL ASSISTANT DESCRIPTION

This PA part of our System is purely software oriented as all the tasks occurring in the PA are achieved using APIs and software calls to achieve the objective as required by the User. As mentioned in the Abstract, it is mandatory for all PAs to perform certain actions to qualify into that category hence some of the modules in our PA will perform functions that do not add to the novelty of the same but enable the User to use our PA as a single trusted source of services.

The modules of our PA and their description are as follows:

A. Chat Interface

The Chat Interface is one which, like any other Chat Application that is either exclusively built for that purpose or aids in its ultimate purpose, allows Users to communicate among themselves after receiving permission from each other to do so. Although our Chat Interface replicates most Systems available in the Market, we wish to try out a new Timestamp based Cipher which will add to the security aspect of the Interface without the need for additional data to encrypt or decrypt the sensitive Chat text. Most of the other Chat Systems utilize techniques such as RSA and MD5, which use external data to pass the message through several rounds of encryption. Our Chat Interface uses the already existing Timestamp details that are recorded along with the message at the time of the sending process in order to convert the plain text to a cipher text. In that, the Algorithm equipped by our Chat System dynamically varies its usage of the Timestamp such that no external party can exploit the same.

For achieving the Chat functionality, we have used databases in our Server, which will record the messages, timestamp, and IDs of the Users involved in the respective Chats. Further, we also use the Firebase Push Notification API that assists us in notifying the User about the reception of messages from different Users in the Network.

Algorithm 1: Timestamp based Chat Cipher

i. Encryption

```
message = getMessage();
timestamp = getCurrentTime();
ev1 = encrypt_1(message, timestamp.p1, timestamp.p2,
timestamp.p3);
ev2 = encrypt_2(ev1, timestamp.p4, timestamp.p5,
timestamp.p6);
sendMessage(ev2, timestamp);
```

ii. Decryption

```
message = getMessage();
timestamp = getTimestamp();
dv1 = decrypt_1(message, timestamp.p4, timestamp.p5,
timestamp.p6);
dv2 = decrypt_2(dv1, timestamp.p1, timestamp.p2,
timestamp.p3);
showMessage(dv2);
```

*where $p1$, $p2$, $p3$, $p4$, $p5$ and $p6$ are the individual parameters of the variable timestamp which will be derived from the same by parameter extraction

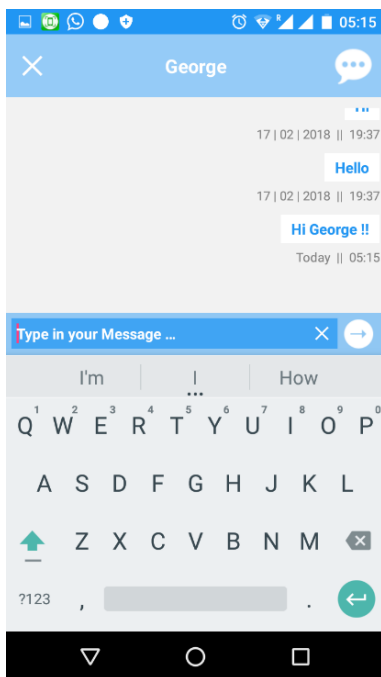


Figure 1: Chat Interface

B. Social Media Tasks

Though it is often possible for PAs to assist Users to send Emails and Messages to other Users, there was a potential for our PA to carry out other Social Media Tasks such as sharing and posting on Facebook and Twitter which is what we aim to achieve through this Module.

For this purpose, we have used APIs from Facebook and Twitter to get the text from this Module, as delivered by the User, and post it to their respective Social Media Accounts. The User will need to register with the respective Accounts initially from whereon the Module will take care of sharing the content from within the PA.

C. Weather Forecast

The Weather Forecast Module is a comprehensive description of the Weather conditions of the location where the User is located. For this, the latitude and the longitude of the User are collected and delivered to the OpenWeatherMap API along with the private key that we have received upon registration. The result set will be in JSON format from which we derive the essential information and structure it according to the design of our User Interface, which is built to be unique and user-friendly in nature.

There are three sections in the Weather Forecast Module based on the time aspect of the data namely the current forecast, the hourly forecast for the succeeding 48 hours and the daily forecast for the succeeding 10 days. All these sections of data are received when the same three data are passed from the User's side with different URLs denoting different results.

D. Alarms, Reminders and Notes

The Alarms, Reminders and Notes Module is a cumulative Module where Users get to set up Alarms, Reminders which are a combination of Reminder Texts and Alarms at specific points of time and Notes which are combination of Texts that are related to each other.

For this purpose, our System will predominantly use the SQLite Database to store the texts locally, especially when offline, and then transfer the details to the online server when connected to the Internet.

E. On-Device Application Management

The On-Device Application Management Module enables the User to perform small tasks such as making Calls, sending Messages, opening Apps and accessing the Camera. In order to achieve this, the Module utilizes the permissions

granted by the Android device to the App in order to access such services and features.

F. News Feed

The News Feed Module delivers News Articles from across the globe on trending topics. For this, we have integrated our App with the Google News API that will deliver results on the latest topics, which we will use in order to display it in our user-friendly interface.

G. Map Interface

The Map Interface is yet another feature that the User can use in order to retrieve direction details between two locations. For this purpose, the User will first have to enter the 'from' and 'to' locations or select their own location for either and then click the ok button. The Map API takes up the two locations and the key in order to retrieve the shortest route between them, their distance and the transit time to draw it onto the Map and display it to the User.

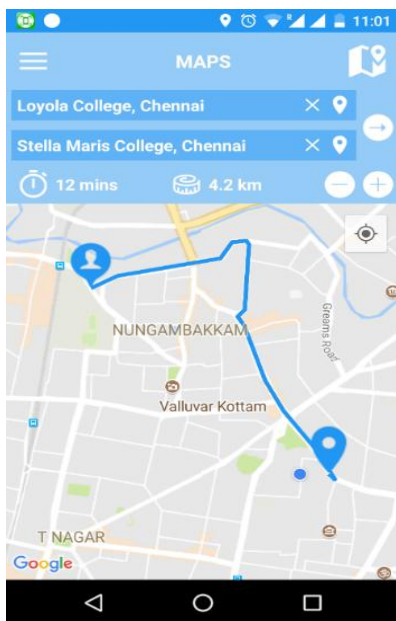


Figure 2: Map Interface

H. Search Engine

The Search Engine Module is similar to the News Feed API except for the fact that the search results retrieved from the Google Custom Search API will be based on the Search Text that the User gives as the input to the Search Box in our Application. The search results will be predominantly in text format though integrating images and videos will be an integral part of our future work.

IV. HOME ASSISTANT DESCRIPTION

The HA part of our System is where the integration of the software with the hardware occurs along with the innovation involved in it. In that, the HA utilizes an Arduino powered by the ESP8266-01 Wi-Fi Module so as to integrate the concept of remote control of Home Devices with the help of IoT. The reason these components are used over other existing hardware is the low cost-factor involved in its acquisition and implementation. Further with the use of a Thingspeak Cloud Server, the sensed data from the Controllers are transmitted to the Cloud from where the PA's HA Module derives data both for monitoring and control, in which case the data in the Cloud will be replaced by the HA's control data. The main objective of our HA will be to allow Users from remote locations to access, monitor and control devices at their homes, which will initially work preemptively with the use of PIR Sensors and further with the intervention of the User. The uniqueness of our HA over others that already exist in the Market include:

- Reduced Cost due to a) cost-effective hardware used to implement our idea b) use of already existing devices that need to be controlled thereby making it smart as compared to other HAs where the devices need to be upgraded to be smart
- Easy Implementation of the Technology despite the complexity in the working of the same
- Effective Monitoring and Control through the PA's HA Module
- Use of the Cipher used in the Chat Module as mentioned in Algorithm 1 to provide security to the data used for Device control

Algorithm 2: Home Assistant Working

```

i.      From the Controller's End
while (True)
    cloudDeviceControl = getCloudData();
    personExist = monitorArea();
    if (cloudDeviceControl != null)
        if (cloudDeviceControl == 0)
            state = turnOffDevices();
        else if (cloudDeviceControl == 1)
            state = turnOnDevices();
    else
        if (personExist == 0)
            state = turnOffDevices();
        else if (personExist == 1)
            state = turnOnDevices();
    uploadDataToCloud (personExist, state);

ii.     From the User's End
while(True)
    personExist = retrievePersonFromCloud();
    state = retrieveStateFromCloud();

```

```

setValuesToModule(personExist, state);
userState = getUserControlledState();
uploadDataToCloud(userState);

```

*where *personExist* is the value indicating the existence of a person in the Area as detected by a PIR Sensor and *state* is the current state of the Devices

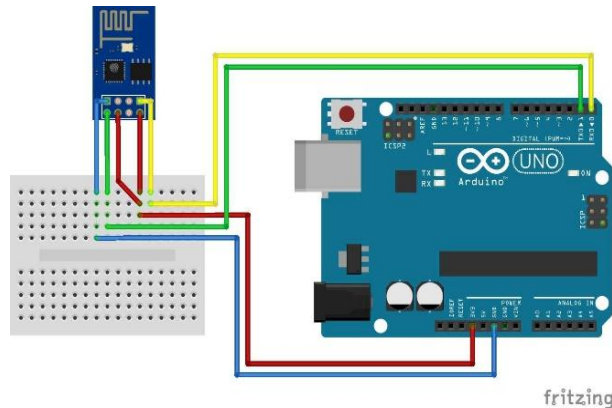


Figure 3: Arduino + ESP8266

V. CONCLUSION

The sole purpose of PAs is to deliver as many services to the User as possible from one platform thereby making it a SPoA. Different PAs vary depending on the type and the number of services that they provide thereby making it mandatory for us to select a specific and unique range of applications while having to create something novel and useful. We have seen PAs that are used in the Medical Field with varied applications such as in Mobile Health Environments and Patient Medicine Prescription. In our PA we have been able to achieve the integration of a few common services that we believe would be sufficient to cater to the needs of general Users when they wish to utilize very basic services. Further, we were also able to integrate PAs with HAs thereby making it novel in its own perspective not forgetting the unique and cost-effective nature of the HA that we are putting in place with the help of an Arduino, ESP8266-01 WiFi Shield and Thingspeak Cloud Server without the replacement of existing devices rather making it smart by nature. In addition, the implementation of a Timestamp based Chat Cipher, which can be used in other services, and the integration of Social Media Tasks, which help the User to carry out many of the actions on their Social Media Accounts directly from our PA further, adds to the value of our System. Despite this as mentioned below, we have many objectives for future versions of our PA for which we plan to carry out further research:

- Integrate more functionalities that are feasible and necessary

- Enhance the feature set of those functionalities that already exist with inputs from various Users so as to add only those features that are necessary in their daily life
- Enhance the User experience of all the functionalities
- Develop auto configuration mechanisms that can be used in the embedded devices so as to enhance the scope of expansion of our HA without needing to manually set up our System from time to time either during installation or maintenance
- Make it available in all platforms including iOS, Web and Windows

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Authors Profile

Mr. F.M. Thomas is currently pursuing his final semester in B. Tech. Information Technology at LICET. He has published two Android Applications titled Febulous and FebuWeather on Google Play Store and Amazon App Store. His IoT project titled Irrigation Controller System using Arduino, Android and Sensors bagged the third prize at the innawah competition held at IIT Madras in



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