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Abstract. Internet of Things (IoT) shows no sign of slowing down, particularly in the field of mobile applications because many IoT devices can be controlled through an application on a smartphone. There is a clear intersection between the Internet of Things (IoT) and artificial intelligence (AI). IoT allows you to connect machines and use the data generated from these machines. Artificial intelligence is the simulation of intelligent behavior in different kinds of machines. Leading manufacturers like Samsung and Apple obviously participate in the rise of artificial intelligence. The implementation of artificial intelligence (AI) and Internet of Things within terminals with touch screen is spreading at lightning speed in smartphones. With the advantage of detecting objects in front of the camera of lowering energy consumption and better guaranteeing data security than the traditional approach in the cloud. In this paper, authors proposed and present a home automation system to connect artificial intelligence (AI) and internet of things (IoT) controlled with a smartphone.
The IoT system proposed allow any user to manage his house on site or remotely to fight against any intrusion or other natural disasters (Wind, Erosion, etc ...) that can cause considerable damage. This solution based Raspberry Pi technology, consist to manage and monitor a home remotely without human intervention by automating the entire house.

Keywords: Artificial intelligence, IoT, Smartphone, Mobile applications, Smart home.

1 Introduction

Today, the mobile phone market is currently experiencing a revolution, from a simple mobile phone to make calls to an advanced phone with capabilities close to a real computer called Smartphone. The evolution of the field of mobile comes from the increasing use of mobile devices with touch screen such as smartphones and tablets as well as operating systems (Android, iOS, Windows Phone). This increased use of

mobile devices is making the mobile application market more and more widespread, and businesses face a great challenge in developing mobile applications that meet the needs of users, taking into consideration the release of new mobile devices and the different platforms.

This increase comes from the power of devices that keeps increasing and the new features they offer. The Internet of Things (IoT) shows no sign of slowing down, particularly in the field of mobile applications. It is currently possible to do everything with a smartphone using different mobile applications.

Apps that installed on smartphones and that work independently of others. They allow access to all the features of the Smartphone and the operating system installed (list of contacts, internet, GPS, etc.). On the contrary, smartphones are getting smarter. It is now possible to follow training sessions with your Smartphone, check your bank accounts, make purchases, etc. This makes smartphone applications almost limitless.

In this paper, authors will present an IoT system allowing any user to manage his house on site or remotely to fight against any intrusion or other natural disasters (Wind, Erosion, etc ...) that can cause considerable damage. This solution based Raspberry Pi technology, consist to manage and monitor a home remotely without human intervention by automating the entire house.

The rest of the paper is organized as follows: the second section defines the background. The third section presents the artificial intelligence and IoT uses in mobile applications. The fourth section presents the different steps of IoT architecture. The case study presents an IoT system for controlling and supervising a smart home is the main object of the fifth section. Conclusion and future work are presented in the last section.

2 Background

The Internet of Things has arrived from smart fridges, to internet connected light bulbs and web-enabled cars, it is a term that is becoming more widely known, and is a revolution in technology that will affect us all. The Internet of Things (or IoT) is simply a phrase to describe any 'thing' that can be connected or controlled via the Internet. These 'things' range from objects in the daily life like a kettle, or central heating thermostat, to connected cars, and lighting systems for 'smart cities'. These are based on existing or evolving interoperable information and communication technologies (Fig. 1). As for the technical point of view, the IoT consists in digitally and standardly identifying an object thanks to a wireless communication system (Zigbee, Wi-Fi, RFID chip, Bluetooth or Infrared) [1].

The very rapid growth of Internet connected devices, ranging from very simple sensors to highly complex cloud servers, shapes the Internet of Things, where Things, in this context, refers to a wide variety of objects (e.g. smart bulbs, smart locks, IP cameras, thermostats, electronic appliances, alarm clocks, vending machines, and more).

The resemblance between all IoT objects is the ability to connect to the Internet and exchange data. The network connectivity feature allows controlling objects remotely

across the existing network infrastructure, resulting in more integration with the real world and less human intervention. The IoT transforms these objects from being classical to smart by exploiting its underlying technologies such as pervasive computing, communication capabilities, Internet protocols, and applications [3]. Protocols are required in order to identify the spoken language of the IoT devices in terms of the format of exchanged messages, and select the correct boundaries that comply with the various functionality of each device. Applications determine levels of granularity and specialty of the IoT device and how big are the data generated for analytics purposes.

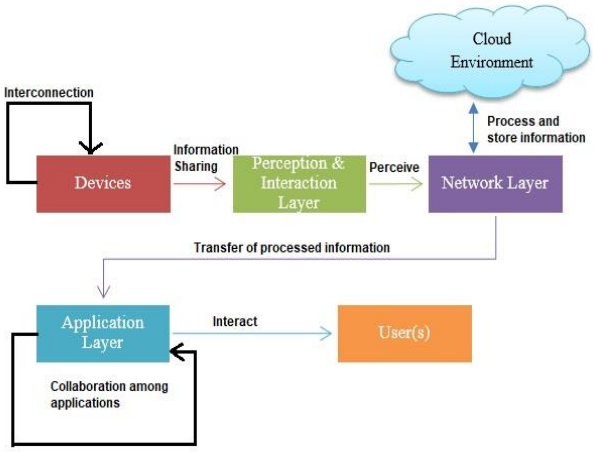

Fig. 1. Deployment diagram in IoT [2]

3 Artificial intelligence and IoT in mobile apps

Artificial Intelligence (AI) is a scientific discipline whose role is to increase knowledge in different areas of mental and social functioning, using computers as tools to experiment with models [4]. To this end, the IA approach operates in four main areas: understanding natural languages, artificial vision (associated with robotics), learning, and Expert Systems [5]. Important application areas for the AI on smartphones. The definition of artificial intelligence has gradually transformed into two totally different and complementary domains: AI so-called "strong" and the AI so-called "weak".

- **The strong artificial intelligence** aims to conceive not only a machine capable of reasoning like the human, but also to experience real feelings, a consciousness and understanding of one's own reasoning.
- On the other hand**, the weak artificial intelligence** implements all available technologies to design machines capable of helping humans in their tasks. It is an approach from an engineering point of view: to seek to build more and more autonomous systems, algorithms capable of solving problems.

The emergence of artificial intelligence will affect many areas of application in the coming decades.

In medical industry. has become an interesting area for artificial intelligence applications, including medical record analysis and medical imaging. Authors in [6] give an overview of facial recognition technology, describe its current applications, and discuss its relevance in the field of plastic surgery. This field has so far largely benefited from weak AI.

In automobile industry. With self-driving and assisted driving. Authors in [7] presents an overview of the applications of AI to a variety of transport-related problems mainly in traffic management, traffic safety, public transportation, and urban mobility.

In security. It is now possible to design machines that recognize the main characteristics of the face, or even reproduce them on a computer. In [8] proposed an automatic system capable to distinguish people's gender by analyzing their faces on computerized images.

Rodrigues et all [9] developed an artificial intelligence based Web tool using HTML, CSS and JavaScript. This tool uses facial recognition for computer animation applications. This allows producers to create animations and simulate the facial movements of actors in a digital environment.

In Home. For many years, artificial intelligence (AI) has been invading our daily lives to help us in our tasks or to give us more experiences that are realistic. In fact, artificial intelligence today thought to simplify the life of human beings. Min Lia et all in [10] analyze the characteristics of smart home, give the smart home composition and the application of smart home key technologies; and key equipment allowing the illustration of the design of smart home electricity service system and related communication systems. Paper [11] implements an IoT Robot to sensing the environment for smart home. They provided the robot with a steerable camera to view the environment controlled remotely by sent commands.

Intelligent positive computing leverages mobile, wearable, and IoT devices such as smartphones, activity trackers, voice assistants, and smart sensors. Smartphones are equipped with various sensors (e.g., GPS, motion sensors, compass, ambient light, camera, and microphone). Mining sensor data facilitates an improved understanding of user contexts and detection of various events of interests [12].

Several platforms, such as SmartThings [13] and Sen.se Mother [14], provide the central hubs that wirelessly connect multiple sensing and actuation devices. Sen.se Mother [14] has motion tags called Motion Cookies attached to any kinds of trackable objects (e.g., pillbox, keys). Voice assistants include Amazon Echo and Google Home, which provide natural language support for information activities (e.g., Q&A) and device control (e.g., turning off the blubs). The IoT hubs, such as SmartThings Hub, also support this kind of IoT device controlling.

4 IoT Architecture

In this section, authors present the different steps of IoT architecture. This architecture is composed of five main stages presented in the figure 2 below.

- **Stage 1. Networked things** (wireless sensors and actuators): The main feature of sensors is their ability to convert information obtained in the outside world into data for analysis. Thus, it is important to start with the inclusion of sensors in the five main steps of an IoT architecture framework so to get information about the appearance that can actually be treated [15].
- **Stage 2. Sensor data aggregation systems and analog-to-digital data conversion:** This step involves digitizing and grouping the data for further analysis [16].
- **Stage 3. The appearance of edge IT systems:** In this step, the prepared data is transferred to the IT world. In particular, computer systems perform enhanced data analysis and preprocessing, calling machine learning and visualization technologies.
- **Stage 4. Analysis, management, and storage of data:** The last process takes place in the cloud or data center. Precisely, it allows in-depth processing, along with a follow-up review for feedback. In this phase includes the highest-level analytic skills, both in the digital and human worlds [17].
- **Stage 5. Visualization and control:** This step consists of viewing the analyzed data with precision. Also, allows transmitting commands to different IoT devices [18].

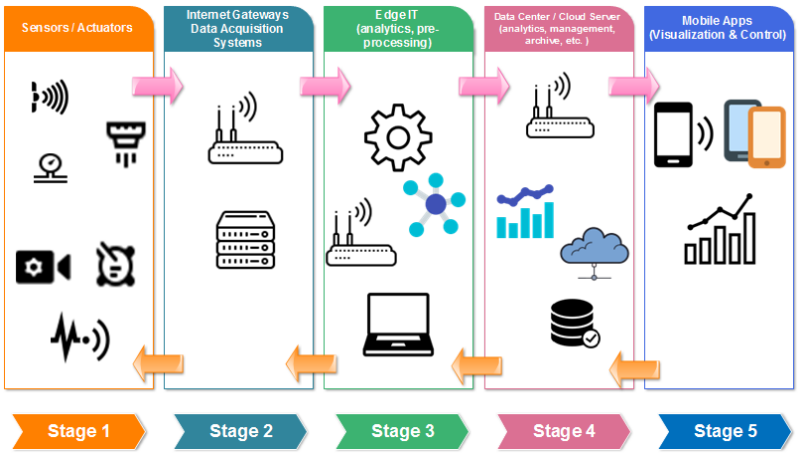

Fig. 2. IoT Architecture

5 Case Study

In this case study, authors will present an IoT system for controlling and supervising a smart home.

5.1 Concept of smart home

Smart homes play an important role in building smart cities. Smart homes can be used to remotely monitor and control electrical devices installed within an intelligent physical infrastructure. In "smart home", the word "smart" means context aware, which can be achieved using information and communication technologies (ICT) and IoT. The figure below illustrates the concept of a smart home.

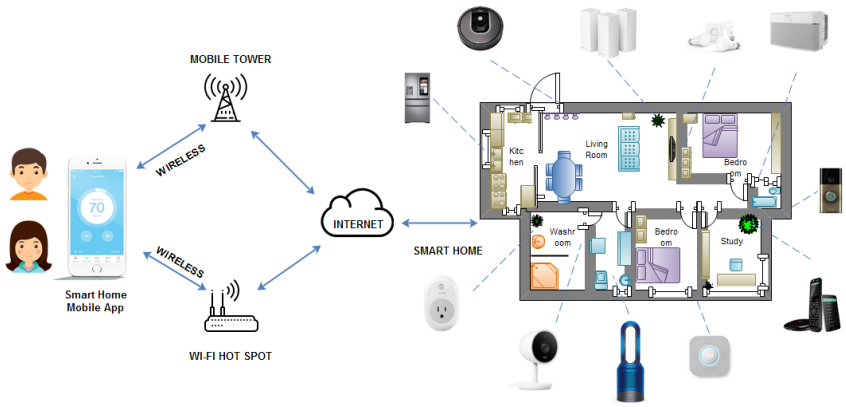

Fig. 3. Smart home concept

5.2 Functional requirements

The system proposed in this article consists in managing and monitoring a remote home without human intervention by automating the entire house with a smarter method. According to the explanations or the way of operation of an ordinary house made in the specifications according to conditions, it is important to adapt them to our system by making it intelligent by giving functional specifications, which described in the table below.

The functional specifications necessary for the different conditions for the correct functioning of the system having been made, it is important to also specify what to display and what to configure.

- **DISPLAY**: Temperature, Humidity, Brightness, PH of water, Alerts or alarms
- **PARAMETERS**: Temperature, Humidity, Auto setting, Brightness rate

5.3 Technical architecture

For the implementation of this solution, authors opted for the following hardware architecture. This architecture based Raspberry provides an all-in-one solution. Home automation controller and Radio frequency (RF) gateway.

The gateway is the brains of the operation. Thus, allows:

- to send and receive messages from / to the nodes using the radio (NRF24L01), XBEE, Wifi.

- To publish messages from nodes in a section of MQTT broker.
- Home automation controller (OpenHab, Home Assistant, Domoticz, etc.), also installed in the same Raspberry Pi, uses the MQTT broker to consume and publish messages from and to the nodes.

The gateway, in essence, brings everything together to provide a seamless experience.

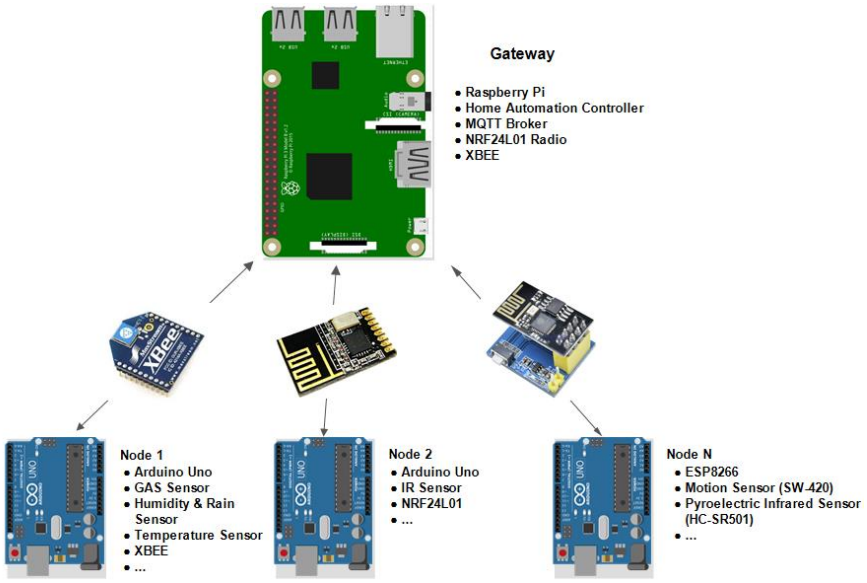

Fig. 4. Hardware architecture

5.4 Achievement

In this part, a presentation of the model made to implement a prototype of the smart home is illustrated. Follow-up, an implementation of OpenHab [19] and the different edits made.

Model made

The figure billow illustrates the model of the house.

Fig. 5. Home realized prototype

Setting up

The figures below show some implementations of some realizations.

Figure 7: Detection system using a presence sensor indicating in real time if there is any suspicious activity around the house but here in particular it implemented in the children's room.

Figure 8: System allow watering of the garden however, the humidity level is very low using the pool water via of a pump.

Figure 9: DHT sensor, which allows the level of methane to be monitored in order to avoid any concern of fire in the house.

Figure 10: DHT11 sensor whose role is to lower or increase the temperature depending on the climate in the living room, in the bedroom, etc...

Fig. 6. Raspberry card and Arduino board

Fig. 7. Presence sensor

Fig. 8. Humidity Sensor

Fig. 9. Methane Sensor

Fig. 10. Temperature Sensor

Fig. 11. Relay

Software solution

The figures below show an implementation of OpenHab on Smartphone and tablet.

Fig. 12. OpenHaB on Tablet

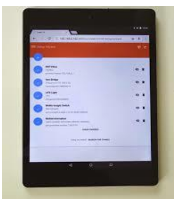

Fig. 13. OpenHaB on Smartphone

6 Conclusion

The purpose of the AI is therefore to have all the appearances of the intelligence (human or rational); authors insist on the fact that the internal functioning of the AI system must also resemble that of the human being or be rational. The main components of an AI system must be knowledge, reasoning, natural language understanding and learning.

Not to mention the combination IoT and IA causes real perceptual changes. Here are five key areas that benefit from this explosive combination. The contribution of artificial intelligence causes real upheavals in different areas.

The IoT and AI couple can bring about profound changes in the field of health. Whether at the time of diagnosis of a disease, during treatment or at home follow-up.

The IoT and IA association now seems obvious in the transport sector. It proved that autonomous vehicles would populate our streets in the very near future. They will transport goods, humans and free up time for the billions of people trapped in traffic jams.

In this paper, authors proposed a home automation system to connect artificial intelligence (AI) and internet of things (IoT) controlled with a smartphone based Raspberry Pi technology. Indeed, intelligent homes and thanks to advances in current technologies, human homes can be equipped with systems and tools very useful to relieve the man in the most painful tasks to perform. Smart Home is also suitable for some equipment such as watering the garden, closures (shutters, gate, and garage door), alarm, security, energy (lighting, heating ...), TV and multimedia, etc.

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