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Pervasive Computing Applications using Different Computational Platforms

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Abstract- This paper provides an insight into the concept of computing and their applications. Different computational boards are available in the market for the development of a smart device. Many applications can be developed for the ease of the society. These devices provide great computing functions with mobility too and are smart enough to sense the surroundings. The paper will enlighten some of the important features of the computational platforms and three different applications using them depending on their functionalities.

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Pervasive Computing Applications using Different Computational Platforms

Nicy Kaur Taneja [α] & Dr. S.R.N. Reddy [σ]

Abstract- This paper provides an insight into the concept of computing and their applications. Different computational boards are available in the market for the development of a smart device. Many applications can be developed for the ease of the society. These devices provide great computing functions with mobility too and are smart enough to sense the surroundings. The paper will enlighten some of the important features of the computational platforms and three different applications using them depending on their functionalities.

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I. Introduction

The concept of computingenlightens the utilization of computer technology by involving hardware and/or software. Most of us use the computing technology in our day-to-day life but we may or may not realize it. The swiping of our credit/debit cards, smart phones, metro smart cards etc. utilizes the computing technology. The data was easily shared by distributing them acrosss different computers located at different locations. But due to its shortcomings of variation in network quality, limitation of weight and size of systems and constraint of battery consumption. These constraints led to the research of mobile computing in which each of the three: communication, hardware and software are mobile [4]. It involves mobile networking, mobile information access, location sensitivity and energy saving techniques due to size of devices compared to large computer systems. The mobile device has some characteristics that produces the output depending on its location. For example, if a person sets the ringing of his mobile phone as vibration while in conference and on ringing while travelling then the application will utilize the user's location.

The context-awareness is a part of location sensitivity [1]. It is not only limited to location. In fact it covers time, identity, light and social factors too. The mobile device presents the output depending on its inference from the surrounding characteristics and guides through the information surrounding us.

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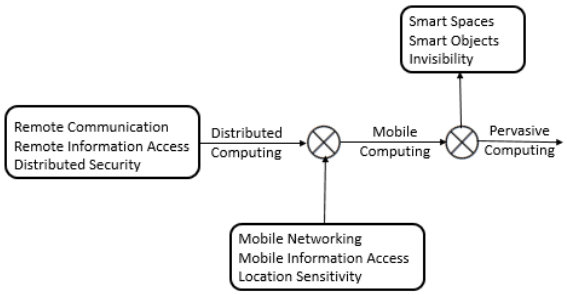

Figure 1 : Trends in Computing

Later on, to make these devices smart, the research led to pervasive computing. Pervasive computing provides an environment in which people interact with embedded processors or computers in a smart way [5].

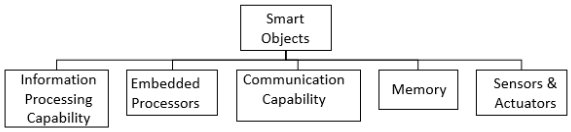

Figure 2 : Hardware and Software Components of Smart Objects

Some of the development boards are used for developing mobile applications whereas some for pervasive applications. The smart objects of pervasive computing application has information processing capability, embedded processor, communication capability, memory and the sensors and actuators.

II. Literature Survey

Komal Tayde and Prof. Amit Bhala [4] described the principles of context awareness, its applications and usability. They also addressed the risks involved in building context aware applications and the solutions to deal with them. Charith Perera, Chi Herold and Min Chen [1] surveyed number of IoT solutions in terms of context-aware technology perspectives. Renuka and Prof. Vijay Bagdi [3] implemented a surveillance system using Raspberry Pi and PIR sensor to send the captured images to user's email id. Deepali and Mukund [5] gave an insight into the concept of context, its need, design principles, models and requirement of context awareness applications. The context models describes how the context data is stored such as simple data structure, hierarchical data

structure, graphical structure or using object-oriented techniques.

III. Computational Platforms

a) Raspberry Pi Development Board

Raspberry Pi is a small computing platform which is not limited to run only on Linux but on Android and Windows operating system too [11]. It provides the hardware ports to connect USB, keyboard, mouse, microphone, speaker, camera, HDMI cable and SD card slot. This hardware platform can be prototyped to design a complete stand-alone computing system. It is best suited for application that requires multimedia support such as camera, audio and video. If the Linux image is used, the programming can be done in Python. If Raspberry Pi uses Windows platform, then the programming can be done using Microsoft Visual Studio IDE.

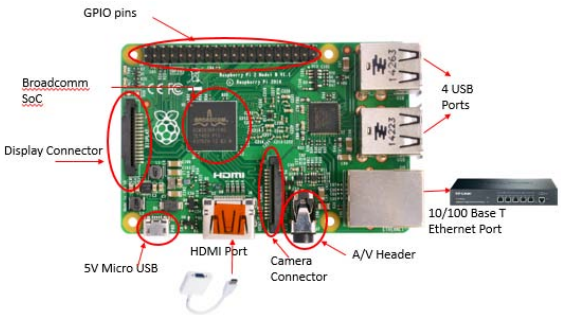

Figure 3 : Raspberry Pi2 Development Board [7]

b) Intel Galileo Gen2 Development Board

A development platform provided by Intel with on-board analog to digital converter. Both analog and digital components can be connected to the board. The supported programming environment is Arduino IDE and Eclipse. It has an Intel Quark SoC x1000 processor [10]. The board can be powered up by using a 12V power adapter. The program running on the board is saved in a flash memory and the memory gets removed after the power is removed. So, I order to save the program, SD card can be used. The board can be connected to the internet through Ethernet.

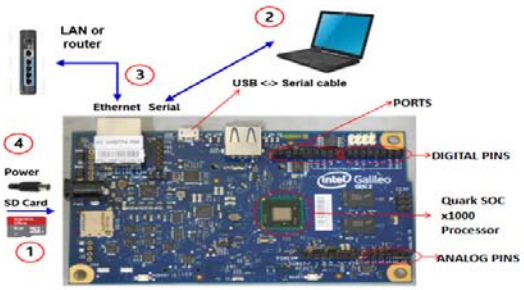

Figure 4 : Intel Galileo Gen2 Development Board [8]

c) ARM MBed Development Board

The Mbed has an ARM microcontroller in which is designed for prototyping low cost USB devices, battery powered applications [6]. It is packaged as a small DIP form-factor for prototyping with through-hole PCBs, strip board and breadboard, and includes a built-in USB FLASH programmer. The board has an interface for both analog and digital sensors. For interfacing communication modules, transmitter and receiver pins are also available. It has a reset button which is used to erase any saved program in the board's memory. It also has four on-board LEDs. It can be programmed using a lightweight online compiler.

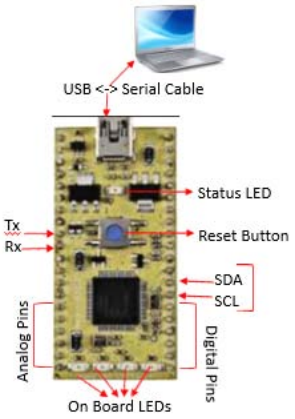

Figure 5 : ARM MBed Development Board [7]

d) Comparison among Different Computational Platforms

The table gives an insight into the difference of hardware features between three different platforms. These differences helped us to effectively select the development board for its application. All the computational platforms has different operating frequencies. Their hardware and software features make them suitable for different applications. Raspberry Pi 2 can be used to design a complete mobile device but its distinctive feature is that it supports video and camera functionality. It has USB ports for connecting mouse, keyboard or other peripheral devices. Whereas Intel Galileo Gen2 can be used to design pervasive devices that are smart enough to sense the environment. ARM MBed board can be used to design smart devices that require less space.

Table 1 : Comparison of Different Computational Platforms

S.No.	Parameter	Raspberry Pi 2	Intel Galileo Gen2	ARM MBed
1.	SoC / Microcontroller	Quad core Broadcom BCM2835	Intel Quark X1000 SoC	ARM Cortex-M0
2.	Max. Operating Frequency (MHz)	900	400	48
3.	Power pins	Either 3.3 or 5V	Either 3.3 or 5V	4.5 to 9V
4.	Application	Suitable for handling media such as photos or video	Suitable for project involving sensors &their monitoring	Suitable for low cost USB devices & battery powered applications
5.	Booting	Boots only from SD card	Can boot from on-board memory + SD Card Support	Can boot from on-board memory
6.	On-board ADC	No	Yes	Yes
7.	Ethernet & USB support	Yes	Yes	USB only
8.	Power Supply	5V	5V for Gen1 but on-board regulator on Gen2 7V - 15V	5V USB

IV. Experiments

After studying the hardware and software features of all the three development boards, different sensors were interfaced with them. This was done to build different pervasive applications on different platforms.

a) *To monitor room temperature using ARM Mbed Development Board*

To monitor the room temperature, LM35 temperature sensor was interfaced with the computational platforms.

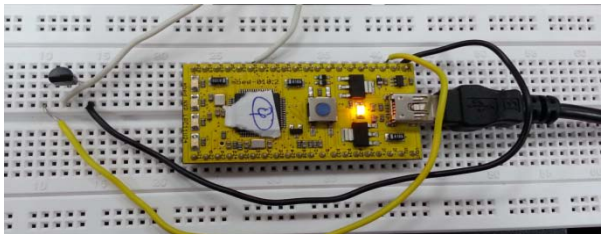

Figure 6 : LM35 interfaced with ARM Mbed

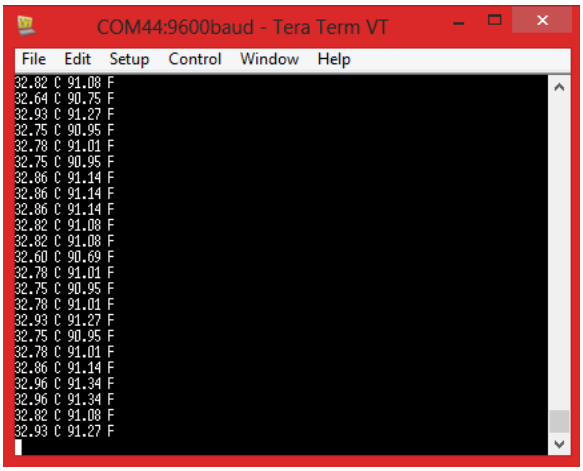

Figure 7 : Temperature Display on Serial Monitor

b) *To capture image using Raspberry Pi Development Board*

For capturing an image, camera was connected to CSI port on Raspberry Pi board. To start the camera, first it has to be enabled and then a python command to capture the still image. The image will be saved with ".jpg" format. Similarly, video can be recorded using the same camera and it will be saved with a ".h264" format.

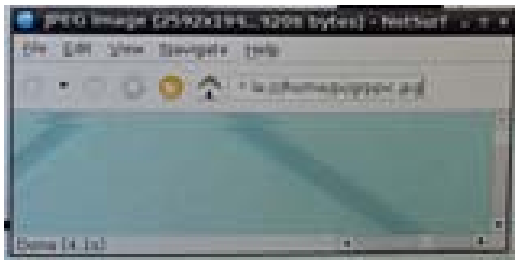

Figure 8 : Captured Image

c) *To detect the motion of a person using Intel Galileo Gen2 Development Board*

The Passive Infrared (PIR) gives the output by measuring the Infrared light emitted by an object in its field. PIR sensor and buzzer were used to detect if any person passes in front of the sensor. When an object having temperature above absolute zero and emits heat energy in the form of radiation, it is detected by the motion sensor. As soon as the motion is detected, the buzzer starts ringing.

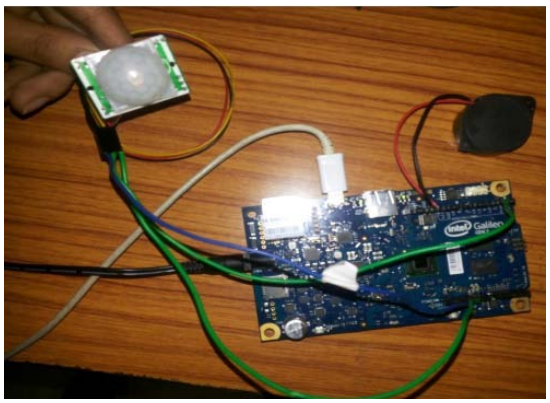

Figure 9 : PIR sensor and Buzzer interfaced with Intel Galileo Gen2

V. Conclusion

The trend of computing helped to understand the present computing scenario in terms of its need, structure and applications to the user as well as the society. The differences among the different computational platforms provides an intellectual understanding of their features. The selection of platform was done successfully to develop different applications based on their functionalities.

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