Development of and Future Prospects for Tablet Devices

● Hiroyuki Yoshizawa ● Makoto Ishida ● Toshinori Yoshitsuru

Fujitsu commercialized a water-resistant, highly functional tablet PC—featuring Long Term Evolution (LTE) and one-seg broadcasting compatibility—for the Japanese market in 2011. With its 10.1-inch, 1280 × 800-pixel screen, high-resolution display, dual-core processor, water resistance (hitherto unusual for a tablet), human-centric functions, and one-seg compatibility, this tablet provides usability unique to Fujitsu. Moreover, by developing a gesture function for improving the tablet's usability in a wet-hands situation and by designing the speaker so that its sound is directed directly at the user for improving acoustic performance as a large-screen entertainment tablet, we have created a device with appealing features that differ from those of smartphones. This report discusses the market trends concerning tablet devices, describes the elemental technologies used to achieve the water resistance and improved entertainment features, and looks at how equipping Fujitsu's devices with a human-centric engine has made it possible to acquire information that has been analyzed on the basis of data collected from numerous sensors and to receive information continuously.

1. Introduction

Following the launch of the iPhone by Apple Inc. in 2007, phones for business use based on the Android open operating system were launched in 2008. In Japan, the mobile-phone market has been shifting rapidly since 2010, from feature phones (equipped with operating systems such as the KDDI Common Platform, which is based on Symbian and Linux) to smartphones based on Android. This market continues to grow and is playing a central role in the market for ubiquitous devices.

One category of ubiquitous devices includes tablet-type devices equipped with an LCD larger than seven inches for which the main purpose is data communication. Devices in this category resemble mini-notebooks and mini-tablet PCs, which are in a different category, in terms of screen size and user-application scenarios, so the markets for these categories overlap. The manufacturers are thus taking different approaches to the development of products for those markets.

Fujitsu has commercialized a water-resistant, Long Term Evolution (LTE)-compliant Android tablet called "ARROWS Tab LTE F-01D" (hereafter "F-01D"), which was launched by NTT DOCOMO, INC. (hereafter, DOCOMO) in 2011. Focusing on the technologies applied in the development of the F-01D, this report describes the targets and future prospects of Fujitsu tablet devices on the basis of future market needs and the directions taken by other companies.

2. Market trends for tablet devices

Three years after launching the iPhone, Apple released the iPad, and the market for "slate-like" tablet devices took off. Following Apple's lead, other companies launched tablet PCs based on the Android open operating system (OS), including Fujitsu's F-01D (**Figure 1**).

There has been fierce competition among manufacturers, and the tablet-PC market is continuing to grow. It is expected to reach 260 million in annual worldwide sales by 2015.[1)] This market is characterized by the participation of both mobile-phone vendors and PC vendors, which makes it substantially different from the smartphone market. Elemental technologies unique to Fujitsu—ranging from ones for devices (namely PCs, mobile phones, and servers) to

Figure 1
ARROWS Tab LTE F-01D.

ones for cloud services—are needed in order to provide better value to users within this market.

3. 10.1-inch water-resistant Android tablet

Fujitsu's water-resistant, LTE-compliant Android tablet (F-01D) launched in 2011 through DOCOMO has earned a good reputation. Fujitsu's development of tablet PCs has been a collaborative effort between the division developing mobile phones and the one developing PCs, and the evolution of LTE models and Wi-Fi models is continuing.

As a basis for making basic features "high-specification" (e.g., adopting a dual-core processor and 1-GB memory), two appealing features unique to Fujitsu, namely, water resistance and improved entertainment, were introduced to differentiate this tablet PC. The application scenarios of this tablet PC were expanded accordingly. The elemental technologies that constitute these appealing features are described in the following subsections.

3.1 "Its screen is big enough for it to be used while in the bath!"

Since launching the F703i water-resistant mobile phone in 2007, Fujitsu has added water resistance to its mobile-device lineup, and from the design stage onwards, we have been investigating the addition of water resistance to tablet PCs as well. As for application scenarios of tablet PCs, the appealing already offered features such as browsing recipes while busy cooking and operation even with dirty hands needed to be expanded, so we investigated the application of tablets in the bathroom. This involved implementing the capability of operating in a high-temperature and high-humidity environment by ensuring water resistance of the large screen and devising means for alternative operation, i.e., operation with wet hands (which a touchscreen has difficulty in detecting).

Since the LCD of a tablet differs from that of a smartphone, it was first necessary to ensure the rigidity of the body although water resistance of the large screen was already ensured. In the case of a smartphone, the know-how acquired in the development of feature phones can be applied. In contrast, when a device gets to the size of a tablet PC, its body must be strengthened. Although we investigated using metal for the body as a strengthening measure, we decided to use conventional molding materials in the interest of saving weight. We used structural simulation to identify the weak points in the molded body. Then, by improving body rigidity at those points, we attained water-resistant performance that gives the user peace of mind.

The positions of the analysis areas on the tablet rear case are shown in **Figure 2 (a)**, and the simulation results are plotted in the graph in **Figure 2 (b)**. From the results, the changes in pressure in each area were determined, and appropriate measures for increasing strength in accordance with the weak points were worked out.

In addition to having a robust body, the tablet must operate under the conditions of high temperature and high humidity found in a bathroom. We performed temperature-cycling tests on a tablet under conditions close to those of a bathroom, noting the big difference between the temperature of the bathroom and an adjoining dressing room. We also carried out temperature shock tests under stringent conditions.

Operation by touchscreen with wet fingers was investigated next. Drops of water stick to an electrostatic-capacitance touchscreen when a wet finger touches it, and they can cause the screen to react errantly owing to the electrostatic capacitance of the water. Moreover, it was necessary to solve the problem of having to wash one's hands and dry them before operating the touchscreen when the tablet is used in the kitchen for viewing recipes. Aiming to solve that problem, we developed a gesture function that

enables the tablet to be operated without having to touch the screen. This function recognizes hand movements by means of the built-in camera and executes predetermined functions in response to specific hand movements (**Figure 3**). The tablet is thus usable in wet-hands situations.

3.2 "Since the screen is big, I want to enjoy entertainment too!"

1) "One-Seg" broadcasting TV capability

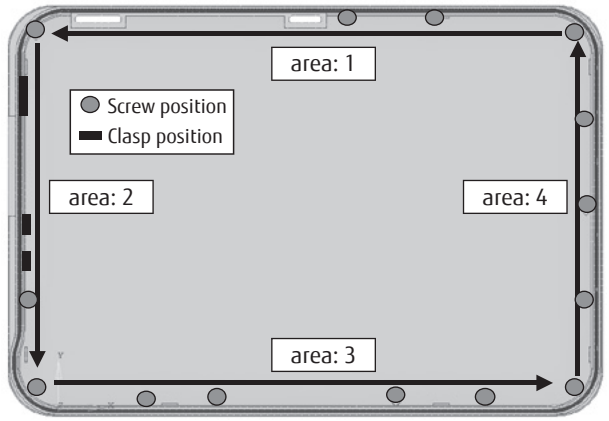
As the world's first "one-seg" broadcasting compatible tablet, the F-01D was designed so that one-seg TV can be watched on its large screen while in the bath. Compared to the screen size of a water-resistant smartphone, that of a tablet makes a tablet better suited to being set in place beside the bath and viewed without holding it.

When investigating the creation of a large screen, we realized that simply enlarging the low-resolution one-seg screen would result in indistinct images. Accordingly, we used display-image-size optimization and image processing like that used by Fujitsu for feature phones and smartphones to devise a way to present easy-to-view images.

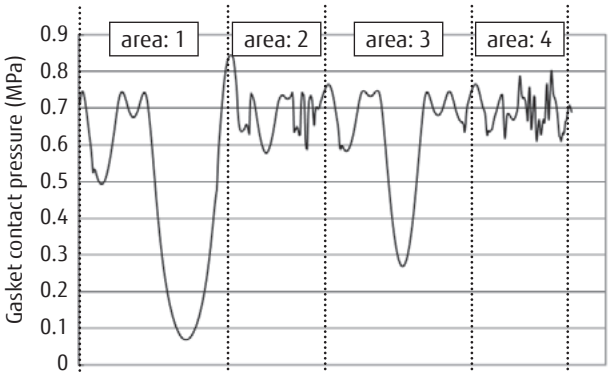
2) User directed sound

To improve the entertainment features of the F-01D, specifically in regard to sound, we took a different approach to that taken for smartphones. The F-01D uses 3D surround sound and equalization to maximize the sound quality. More specifically, it is configured so that the sound from the speaker is carried toward the mesh surrounding the screen, resulting in the sound being output right next to the screen (**Figure 4**).

We determined that using a metal mesh and simple mesh processing would substantially degrade



(a) Position of each analysis area on rear case



(b) Pressure generated on gasket

Figure 2
Structural analysis simulation.

Figure 3
Device operation using hand gestures.

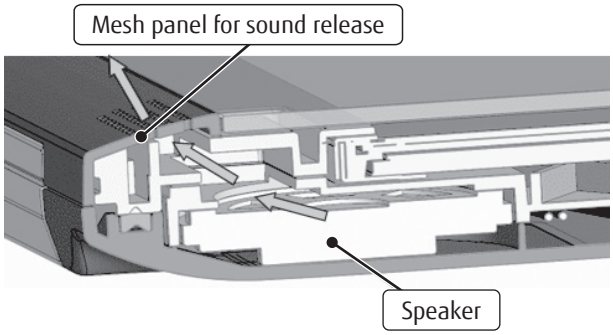


Figure 4
Front-speaker configuration.

the performance of the internal antenna and increase the tablet's weight. Therefore, to create a good design, ensure antenna performance, and reduce the weight, we determined the appropriate gate number and pin shape for the mold and made the mesh panel out of plastic. In this way, we created a tablet device with the characteristic design shown in **Figure 5**.

3.3 An easy-to-use device for old and young, male and female alike

Having aimed to improve the usability of devices since the era of feature phones, Fujitsu is making use of sensing technology (a specialty of ours), universal technology, and sound technology—on the basis of Fujitsu's unique way of thinking, termed "human-centric"—in introducing technologies for providing the ultimate ease of use and affecting the three sensations of hearing, sight, and touch.

A great many functional components (such as camera, microphone, gyroscope, acceleration sensor, geomagnetism sensor, touchscreen, color sensor, temperature/humidity sensor, and GPS) are fitted in smartphones and tablets, and in the future, information gathered from all these components will be processed by a "Human-Centric Engine (HCE)"note) and will be utilized in a manner that is useful for people. And functions such as discriminating the colors of the surrounding environment in order to make it easier to view the LCD screen and utilizing information supplied by the acceleration sensor and gyroscope to determine the pace of a jogger could become closely matched to people's lives.

4. Providing new value

If we look at smartphones and tablets from the viewpoint of cloud services, we can consider them to be "sensor devices" that are always carried by the user and always connected to the network in a manner differing from the usage of PCs. In particular, equipping Fujitsu's devices with an HCE has made it possible to acquire information that has been analyzed on the basis of data collected from numerous sensors, not just data from a single sensor. By fusing this information with the "convergence service" provided by the Platform as a Service (PaaS) platform developed by Fujitsu, it is possible to handle various types of existential information by "stockpiling" it as opposed to handling information fragmented along a time scale up to the present.

Figure 5
Front mesh panel.

Furthermore, by handling sensor information from these many sensors as "big data," it is possible to acquire continuous information instead of the fragmented information that passes before our eyes each day. One example is weather forecasts. If weather-forecast information on networks is acquired from positional information on devices, and if more temperature/humidity sensors are fitted to devices, weather conditions can be understood in real time with better accuracy. Conventional devices can do this.

By utilizing our convergence service and by gathering and analyzing information from the positional information of devices and information from temperature/humidity sensors as big data (for example, a device several kilometers from one's own device says that it is raining), it is possible to obtain weather-forecast information, in real time and with high accuracy, enabling the user to find out when it will rain at his or her present location. Moreover, if a third party analyzes and utilizes this accumulated data and information, they can provide information and services that are even more useful for people's daily lives.

5. Conclusion

By fusing sensor technologies incorporated in tablet devices provided by Fujitsu with cloud computing,

note) An "engine" (uniquely developed by Fujitsu) for improving the amenity of the three sensations of hearing, sight, and touch. Through various sensing technologies, it provides functions that are useful to people in their daily lives.

it has become possible to provide behavioral support and information on the basis of a hitherto-unconsidered "human-centric" way of thinking and expand the "Human-Centric Intelligent Society" that Fujitsu is striving toward. We will incorporate such thinking in the services and ubiquitous devices that we will offer in the future.

References

1) "A Survey of Trends in Demand concerning the Tablet-PC Market," ICT Research & Consulting Inc., Apr. 26, 2012 (in Japanese).

Hiroyuki Yoshizawa
Fujitsu Ltd.
Mr. Yoshizawa is currently engaged in the development of tablet devices.

Makoto Ishida
Fujitsu Ltd.
Mr. Ishida is currently engaged in the advanced development of smartphones and tablet devices.

Toshinori Yoshitsuru
Fujitsu Ltd.
Mr. Yoshitsuru is currently engaged in the advanced development of smartphones and tablet devices.