

## A STUDY ON TECHNOLOGY TREND OF CAMERA BY USING FI CODE IN JAPANESE PATENT

Yoshie Ishii<sup>1,\*</sup>, Koji Masuda<sup>2</sup>, Yoshinori Hayashi<sup>3</sup>, Teruaki Mitsuya<sup>4</sup>, Shigeyuki Haruyama<sup>5</sup>

<sup>1</sup> Graduate School of Science and Technology for Innovation, Yamaguchi University, Japan

<sup>2</sup> Innovation/R&D Division, Ricoh Company, Ltd., Japan

<sup>3</sup> Graduate School of Innovation and Technology Management, Yamaguchi University, Japan

**Abstract** *In development of technology and product, it's important to make decisions based on technology trend. Some previous studies obtained technology trend based on patent information. In our previous study, we tried to investigate the state of innovation and the emergence of dominant design by using patent information. We analyzed inkjet printers and NC machines with theme codes and F term codes in Japanese patent classification codes. In this study, we tried to know the change of technology of other products other than inkjet printers or NC machines by using patent information. The target product of this study is camera. Camera products changed its key technology of imaging and recording from analogue film to digital imaging sensor and semiconductor memories. We attempted to obtain this change by using patent information.*

**Keywords** technology trend, Japanese patent, FI, Camera market

### 1. Introduction

In technology development and product development, it is important to make decisions based on technology trends. Some previous studies used patent information in order to obtain technology trends [1]-[12]. In our previous study, we also used patent classification codes in order to obtain the status of product innovation, process innovation and the emergence of dominant design in inkjet printers and NC machines.

In this study, we also tried to obtain changes of technology by analyzing patent information for products other than inkjet printers and NC machines.

The target product was cameras. For cameras that take common pictures, the basic function of recording an image through a lens has not changed for about 120 years. However, 20 years ago, the material for imaging and recording changed from film to an imaging sensor and a semiconductor memory.

It can be said that analog technologies replaced digital technologies. Both film and imaging sensors and semiconductor memories are related to camera imaging and recording functions, but are given different FI codes.

#### 1.1. Purpose of this study

The purpose of this study is to show that it is possible to obtain changes in technology by using patent information on camera products as an example.

#### 1.2. Research Target

Before analyzing patent information on camera products, we researched changes in product sales of film cameras and digital cameras.

Today, we use cameras in various fields such as daily life, industrial fields, and medical fields. In this study, the target types of cameras are shown as Figure 1. A classification used in sales and shipment statistics by the Japan Camera and Imaging Products Industries Association (CIPA), generally intended for cameras that take and save photographs in daily life and hobbies [15]

\*Corresponding Author: [i001wc@yamaguchi-u.ac.jp](mailto:i001wc@yamaguchi-u.ac.jp)

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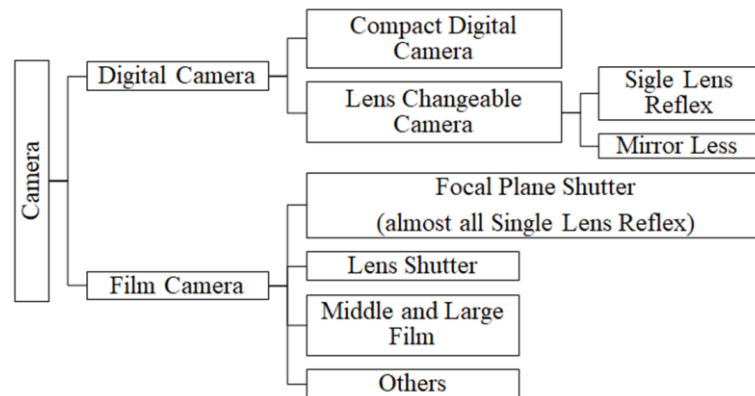


Figure 1. Classification of Camera by CIPA (Camera & Imaging Association)

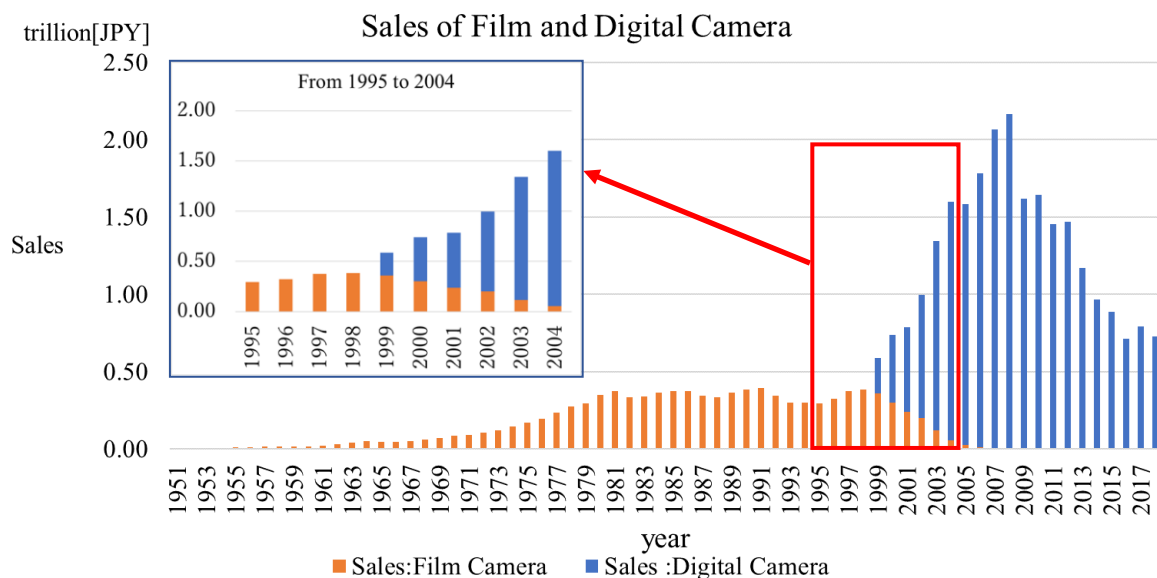


Figure 2. Sales of camera

## 2. 2. Japanese camera market

The results of the research on the sales of the above cameras are shown at Figure 2. The first digital camera for camera products for our common use in Japan is released to the market in 1998. "FUJIX DS-1P" by Fujifilm (Japanese film and camera maker). In 1995 Fujifilm released "FUJIX DS-200F" [16], and in 1995 Nikon released "E2" [17] etc. Then many digital cameras have been released to the market. And in 1999, digital cameras market reached 200 billion yen in sales.

## 2.1. Overview of camera market

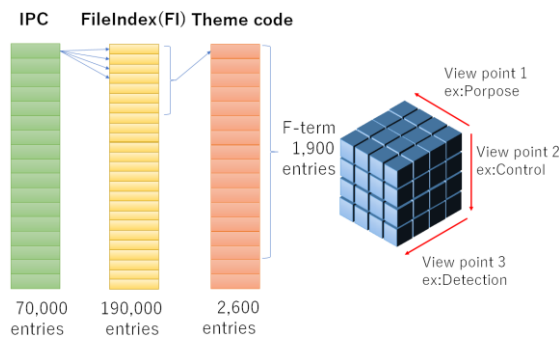
We investigated camera sales in Japan by type of film camera and digital camera, mainly around 1999. As shown in Figure 2, in 2000, digital camera sales exceeded film cameras sales in Japan, and sales of digital cameras have been rapidly increasing since then. Though the sales of film camera have been decreased from 1997, the total sales of camera have increased from the statistics start of 1951 in 2007.

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### 3. Japanese patent code

In this study, we used patent classification code named FI code to obtain the change of technology from film camera to digital camera. At First, we will explain Japanese patent classification system. Japanese patent classification shown in Figure 3. is based on International Patent Classification (IPC). However, in order to classify a large number of patents, IPC is subdivided in Japan and a classification code c called File Index (FI) code is assigned. In Japanese patent classification, in order to enable search from multi viewpoints, some FI codes are gathered and a theme code is added. The theme code consists of multiple F-term codes. F-term is a code that can analyze one patent from multiple viewpoints. For example, the theme code 2C056 for inkjet printers is classified into F-term codes that shows purpose, control, and detection.



**Figure 3.** Relationships between IPC, File Index (FI), Theme Code and F-Term

### 4. Research Methodology

In order to investigate changes in technology using patent information, we selected patent classification code that represents technology related to cameras. The method of collecting the research target patents was learned in the previous research [13]. In the previous study, patents of companies with high market share were collected and used as search target patents, and the strategies of semiconductor exposure equipment manufacturers were analyzed by the patents. About cameras, several companies have high share in the market, and we referred to the selection method of FI and F terms.

We used "Yamaguchi University patent search tool YUPASS" as a research engine. YUPASS is a powerful search engine that has

almost the same contain of patens as Japan Patent Office's one. YUPASS enables us to search patens with various ways and download huge number of patents as csv files.

In the first step, we collected search target data for patent search. Patents of manufacturers with high market share in the market were gathered by YUPASS.

Nikon and Canon were selected as film camera makers because of their high market share [16].

Nikon, Canon, Ricoh, Olympus, Sony, PENTAX and Minolta were selected as digital camera makers because of high market share [17].

After collecting patents, we selected the FI codes. We used the word "camera" as a keyword that showed the product concept. As a example shown as Table 1, the FI codes that explanations includes "camera" were selected.

To avoid the leaks information in the FI code, frequently words "camera" was counted in the explanations of FI codes by text mining software. By obtaining the most frequent word in FI codes' explanations, " imaging sensor" was found as an additional keyword of camera. Then FI codes related with camera were selected again with the keyword "camera" and "imaging sensor". In this way, FI code group related to the camera is determined.

Eighty-four FI codes were selected in this study as camera related FI codes. On processing text mining, we used RMeCab [19] software, a Japanese language analysis tool, for morphological analysis. RMeCab is open source morphological analysis engine developed through the Joint Research Unit Project, Graduate School of Informatics, Kyoto University and Nippon Telegraph and Telephone Corporation (NTT).

We selected the patents assigned FI code related to the camera, and executed morpheme-analyze among [abstract], and selected the top 10 common nouns that express the technology as follows. "image", "imaging", "means", "lens", "camera", "signal", "data", "information", "subject", "optics".

The patents containing the top 10 nouns were selected from the camera-related FI-assigned patents gathered by YUPASS. Nineteen FI codes in this patent group were selected.

G03B1/00, G03B15/03, G03B17/00, G03B17/18, G03B17/28, G03B27/32, G03B3/00, G03B31/00, G03B5/00, G03B7/00, G03B7/08, G03C3/00, G04B47/00, G06T7/70, G11B23/44, G11B31/00, H04N5/225, H04N5/232 and H04N5/238.

We think that there are major technological changes such as film camera technology and digital camera technology from the changes in

the market, read the explanation of FI code, FI code for film camera (eg positioning of photosensitive material in camera), digital FI code related to camera (eg device for adjusting image communication and television camera). Figure 4 shows the procedure to obtain the patents of film camera and digital camera by using FI codes.

Table 1. Select FI Code by The Keyword

Symbol	Title
G	Physics
G03	Photography; movies; similar techniques using waves other than light waves; electrophotography; holography
G03B	Equipment or arrangements for taking pictures or for projecting or looking at photographs; apparatus or arrangements using similar techniques using waves other than light waves; accessories therefor (optical components of such devices G02B; photosensitive materials or Photographic method G03C; processing device for exposed photographic material G03D)
G03B 1/00	Handling of film pieces generally important for cameras, projectors or printers

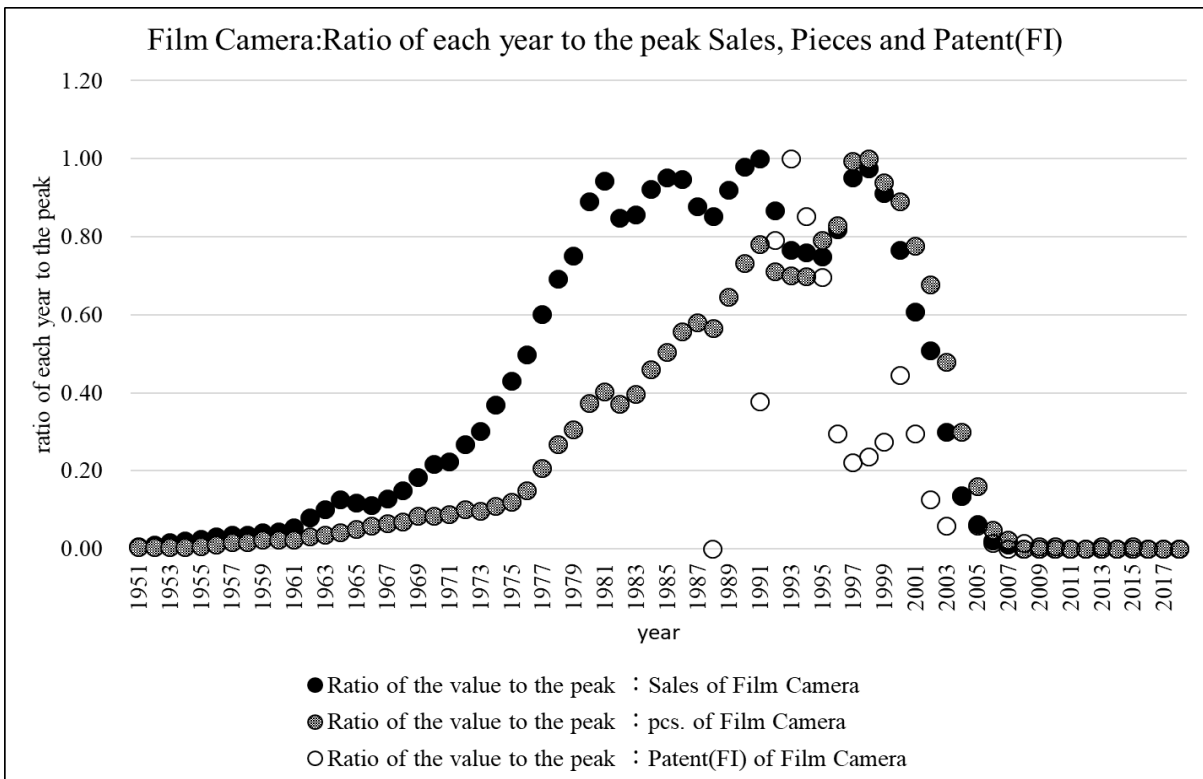


Figure 5. Film camera sales and patent

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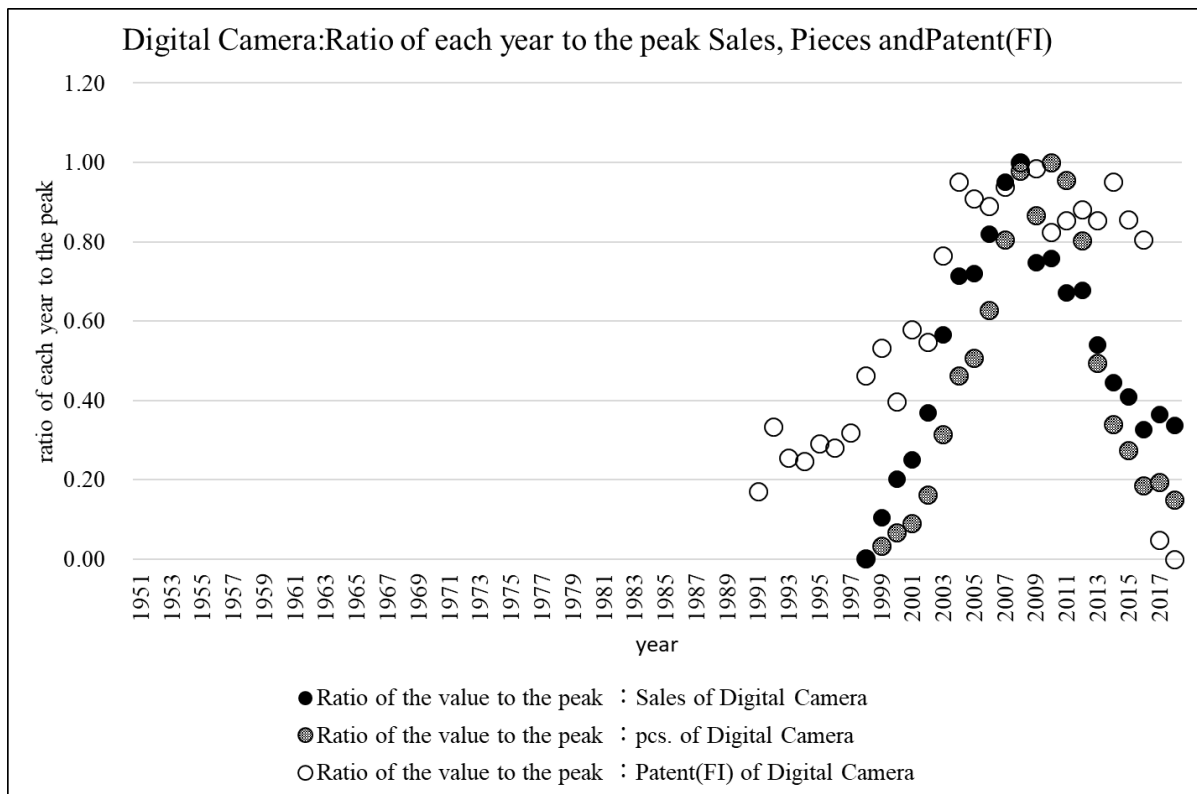


Figure 6 . Digital camera sales and patent

## 5. Result of analysis

The FI code groups of the film camera and digital camera technologies with this way were collected year by year. Sales and number of shipment pieces and the number of patents were shown in the graph. Each kind of number were shown as a percentage to the peak value for film cameras and digital cameras. (Figure 5, Figure 6)

As shown in Figure 5 that shows about film camera's result. In 1993, patent peaked. In 1999, the sales and shipment pieces peaked.

As shown in Figure 6 that shows about digital camera, digital cameras, sales and patents peaked in 2008, and two years later, sales peaked in 2010.

## 6. Conclusion

In this research, we aimed to obtain changes in the technology by using patent information with camera products as a case, especially film cameras and digital cameras. Patent information about film cameras and digital cameras was elected by using FI classification codes and text

mining, and the increase / decrease rate of the number of applications for each FI was examined. As a result, it was found that the patent change rate of digital camera increased at the same time with the decrease of patent change rate of film camera and the patent change rate of digital camera decreased further. From this, it was possible to know the changing of technology by using patent information.

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