IMPLEMENTATION OF COMPUTER VISION TECHNOLOGIES IN THE BUSINESS PROCESSES OF FMCG COMPANIES

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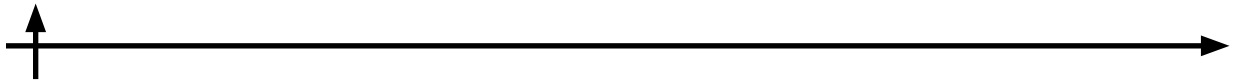LLC Petroproduct-Otradnoe (Kraft Heinz Russia), Otradnoe, Russia

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Abstract. The use of artificial intelligence and image recognition applications in merchandising can significantly improve the sales process and increase business efficiency. Such applications allow to quickly and accurately analyze data, determine customer needs and offer the most appropriate products. The relevance of this research is dictated by directly operating companies in the FMCG segment, as such applications can help to increase sales, quality of customer service and improve business efficiency in general. In the course of writing this article, we analyzed scientific research on the application and development of photo and video recognition systems, researched the market of applications with computer vision, considered the features and subtleties of their potential implementation. As a result, the prospects and risks of implementing IR applications in large international companies were assessed.

Keywords: merchandizing, computer vision, image recognition, apps, FMCG companies

ВНЕДРЕНИЕ ТЕХНОЛОГИИ КОМПЬЮТЕРНОГО ЗРЕНИЯ В БИЗНЕС-ПРОЦЕССЫ FMCG КОМПАНИЙ

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Аннотация. Использование приложений с искусственным интеллектом и распознаванием изображений в мерчендайзинге может значительно улучшить процесс продаж и повысить эффективность бизнеса. Такие приложения позволяют быстро и точно анализировать данные, определять потребности клиентов и предлагать наиболее подходящие товары. Актуальность данного исследования диктуется непосредственно действующими компаниями FMCG сегмента, поскольку такие приложения могут помочь увеличить продажи, качество обслуживания клиентов и повысить эффективность бизнеса в целом. В ходе написания данной статьи, был осуществлен анализ научных исследований на тему применения и развития систем распознавания фото и видео материалов, исследован рынок приложений с компьютерным зрением, рассмотрены особенности и тонкости их потенциального внедрения. В результате, была проведена оценка перспектив и риска внедрения IR приложений в крупные международные компании.

Ключевые слова: мерчендайзинг, компьютерное зрение, распознавание фотографий, приложения, FMCG-компании

Introduction

In today's increasingly competitive business world, companies and entrepreneurs are looking for new ways to improve their sales and make their businesses more efficient. One such way is the use of artificial intelligence and image recognition applications in merchandising. The use of artificial intelligence and image recognition applications in merchandising can significantly improve the sales process. Such applications are used to analyze sales data, customer behavior, and customer preferences (Kellermayr-Scheucher, 2022; Levina and Galanova, 2022). They allow you to quickly and accurately determine which products are most popular with customers, which products are in high demand, and which are not. In addition, artificial intelligence and image recognition applications can help determine which products should be placed on the shelves to attract customers' attention. They can suggest the most effective ways to organize displays that will attract customers and increase sales. This is especially important for stores with a large assortment of products, where organizing space is a challenge. Artificial intelligence and image recognition applications can also help suggest the most appropriate products to customers. They can analyze customer shopping data and suggest items that are most likely to appeal to them. This can improve customer satisfaction and increase the likelihood of repeat purchases. These apps can help improve the inventory process. They can quickly and accurately
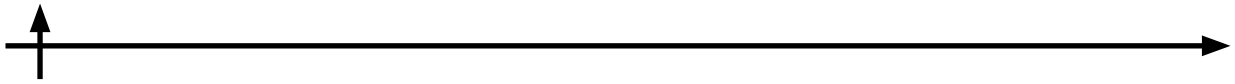
determine which items are in stock and which items need to be ordered. This can help avoid situations where there are not enough items on the shelves, or where items remain unsold due to lack of demand.

Automatic shelf recognition systems are now in their second generation. Technology and engineering has made fantastic leaps forward in the last three years. Recognition accuracy has reached 96-98% for most operators. The time and cost of photo processing has fallen to a level that is acceptable to most customers. As a result, image recognition systems have become the focus of merchandising and retail auditing.

In a few years, fast and flexible learning neural networks have become a technology available to most developers. Now almost all IT professionals can master neural networks. As a result, many solutions have appeared on the market, including those based on "computer vision". Some of them turned out to be in great demand in the retail industry. Neural networks have made it possible to analyze store shelves for the presence or absence of certain products.

Computer Vision (CV) is a field of artificial intelligence that knows how to analyze incoming images and videos. It contains methods that endow a computer with the ability to "see" the necessary data in a picture and then process it (Bikash, 2019; Computer vision, nd.).

The innovative solution consists of a camera (photo or video) and software. Depending on the task, the software can analyze different objects. Teaching a computer to "see" is not easy. You have to "show" it a lot of photos so that it can identify the raw data. The photos should contain different combinations, features, objects. Today the development of CV-systems is far from realizing all its possibilities. The industry is rapidly developing and the range of computer vision applications is constantly expanding. Some people can unfairly fulfill their professional obligations, and merchandisers, like any other employees, need to be monitored. Therefore, developers are trying to solve this problem these days. About 50% of the learning process starts with the material - labeled pictures of items that need to be identified. With their help, we train the neural network to "understand" what is depicted in the image. The goal of this step is to create a system that recognizes the exact model (in our case, the article) of a product from a picture taken on a cell phone or tablet.

Another important step is to continuously train the neural network. Whenever an SKU has new features (e.g. package design, size, label changes).etc.), the neural network is trained to utilize the new features. Let's take a closer look at common approaches and their challenges. The task of recognizing goods on shelves poses several important mathematical problems (Giusti, 2017; Shelf recognition systems, nd.):
− products may be located close to each other;
− products may overlap;
− a catalog of products may contain tens of thousands of items;
− products are constantly being added and removed. New flavors, seasonal offerings, etc.;
− classes are likely to be unbalanced. When collecting data sets, there may be classes with tens of thousands of examples and classes with units of examples;
− shooting takes place in difficult conditions: limited lighting, difficult angles.

There are programs with an additional module "Image Classifier", which automatically recognizes the class (type) of a photo and checks whether it is allowed to use this class of photos in reports of a certain type. The module provides comprehensive analytics for the administrator on the website and for the supervisor in the app. This technology can be very useful for FMCG companies.

Basically image recognition technology can check shelf availability, analyze the shelf share in facing in relation to their competitors and monitor the compliance of display standards (Lijuan, 2022). But in addition, advanced image recognition can also help in finding inactive products
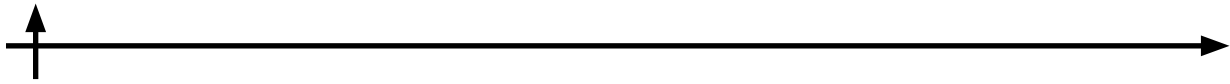
on the shelves. An employee will be able to check whether all products on the shelf are officially manufactured at the moment and identify illegal trade. It is possible to update current matrices (i.e., monitor compliance and changes). Unlike merchandisers, image recognition technology extends to all goods, including those outside the matrix.

Additionally, the shelf share and availability on that shelf can be calculated. Thus, image recognition makes the work of not only merchandisers but also KAMs transparent. One may wonder: how to understand that the recognition is working correctly? Nowadays, neural networks are advanced enough to successfully recognize and classify objects in photos. But some factors can reduce the likelihood of success. There may be too few items on the shelves, there may not be enough light, or there may simply be an error and the item is not recognized (or recognized incorrectly). Here's a solution that a number of companies offer. If a merchandiser notices in the process that some objects are not recognized correctly, he can make a request. A specialist in the application will check it and correct all the flaws manually. Usually such a company has its own team of auditors, which constantly works on verifying the results of automatic recognition and allows you to guarantee quality recognition of objects. Modern technologies become cheaper over time.

Materials and Methods

In the course of the study, an in-depth analysis of existing applications with the recognition function and the experience of their application to date was carried out. The works of leading researchers in the field of using innovative technologies to improve the economic efficiency of FMCG enterprises were reviewed. The research applied general scientific methods such as analysis and synthesis, comparison, and classification for a more fundamental consideration of image recognition models and data processing and transmission schemes.

Results and Discussion

Software vendors claim that time costs are reduced by 40-60% on average. But there are more impressive examples of time savings: up to 80% in a single visit. The speed of processing incoming data increases by almost two orders of magnitude. Most systems process visual data in near real time. A report from the software on compliance with the planogram, calculation of the radius fraction and the number of fasteners is received within 20-30 seconds. The probability of error is minimal. The accuracy of beam recognition systems currently ranges from 92% to 98%. Although there are some "problem" product categories that "mess up the statistics", several problems can be solved at the same time. Several problems can be solved at the same time. A shelf recognition system allows you to control prices and track promotions (availability of promotional materials, special price tags, design of additional outlets, etc.). Routine tasks take less time and staff can be directed to other tasks.

Recognition vendors attract customers by promising fast implementation (one to two months), easy transition from testing to full implementation and easy integration with the customer's CRM system. Automatic recognition solutions can be used for automatic visit quality control (Wang, 2018). This is not yet the most popular option among clients, but probably the most active IR users will soon utilize this functionality. The accumulation of data with visit evaluation allows comparing the effectiveness of individual merchandisers, the long-term dynamics of the quality of their work and the effect of incentive programs. Successes between networks and territories can be compared. In general, a marketer has a lot of opportunities.

All of the above is true when working with a well-trained neural network. Therefore, any supplier of such solutions will first offer the client to conduct preparatory work, to set up the network to work with a particular product, in a particular package and in a particular store.
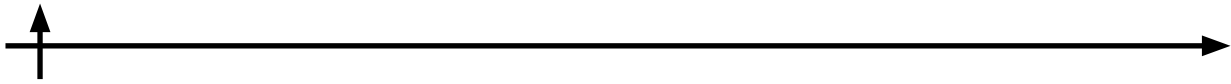
The quality of the materials supplied will determine the success of the entire project. Many developers say that it is better for them to train the system in the field rather than in a "lab" environment. This is a very important point because neural networks "get smarter" as more and more information is downloaded.

Existing experience in the field of recognition applications indicates that there are problems that may arise in the recognition process for various reasons. The main set of problems is summarized as follows:

1. If the photos uploaded to the system were taken under normal lighting conditions and later the store decides to illuminate the shelf with neon lights, the recognition can be significantly impaired;

2. Sometimes it happens that the merchandiser may not be able to take a picture of the entire shelf at once. He has to take several pictures and "assemble" them in the application. This is good if the vendor's software has this "stitching" feature and it works well. Otherwise, distortions and analysis errors may occur;

3. The angle at which the photo was taken can also affect the quality of recognition. It is therefore worth organizing a small workshop among merchandisers on how and what to photograph once the project has started. Vendors almost always provide buyers with tutorials on how to take photos;

4. If the product being photographed is behind glass, glare and reflections can prevent good recognition;

5. Irregularly shaped shelves or product placement can also cause problems.

Interaction with external developers and integration is usually carried out through the customer's IT department, whose employees can set up data offloading from existing systems and, if necessary, coordinate communication and establish cross-team work with any third-party developers. Let's take a closer look at the SaaS service. It can be integrated into any existing business process with minimal integration. The customer continues to use the existing mobile app, but adds new features for product recognition, analysis of key performance indicators related to checkout, and analysis of product reorders. Systems with universal data exchange gateways are preferred by the customer and provide greater flexibility. Lego manufacturer principle. Russia is finalizing the development of a gateway that will allow the SFA system to work with most IR systems. OPTIMUM SkyNet Retail system is fundamentally different from analogues in that the entire recognition cycle takes place on smartphones and tablets and does not require the Internet. In addition, the recognition speed is only one or two seconds (Image Recognition for Retail, nd.; GOSNIIAS, nd.). To date, this is the only image recognition system in Russia that works directly on a smartphone or tablet without an Internet connection. Russian and foreign analogs are software that is installed on a mobile device and exchanges data with servers or the cloud using the network.

Working with data in computer vision applications has its own peculiarities that should be taken into account when developing and using such applications (Face Feature Test, nd.; FaceSDK Video Analysis Technologies, nd.; ResNeXt, nd.). The first peculiarity is that the data obtained by computer vision can be very diverse. It can be photos, videos, scanned images, etc. At the same time, the data can have different quality, resolution, color gamut and other characteristics. The second peculiarity of working with data in computer vision applications is connected with the fact that for data processing it is necessary to use special algorithms and methods of image analysis. These methods can be very diverse and depend on the specific problem to be solved. The third feature of working with data in computer vision applications is that it is necessary to use powerful computing resources for efficient data processing. This is due to the fact that image processing algorithms require a large number of calculations that cannot be
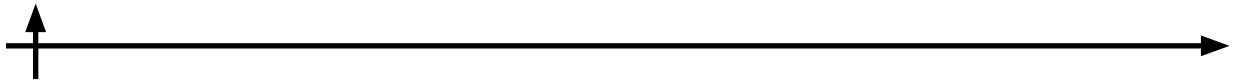
performed on a conventional computer.

Let's take a closer look at how SFA applications for merchandisers work. When working with big data, heterogeneous data is often collected from different sources. In order to work with this data, it needs to be combined. You can't just load them into one database - different sources may provide data in different formats and with different parameters. This is where data blending and integration - the process of combining heterogeneous information into a single format - comes in handy. To utilize data from different sources, the following methods are used (Leading European Online Conference on SaaS Investments, nd.; Yandex Vision, nd.; 3DiVi Face SDK, nd.):

1. Converting data into a common format: recognizing text from photos, converting documents, converting text to numbers;

2. Data Augmentation. If there are two sources of data about the same object, information from the first source is augmented with data from the second source to get a more complete picture;

3. Eliminating redundant data: if a source collects redundant information that is not available for analysis, it is removed. Data blending and integration is necessary when there are several different data sources and you need to analyze the data as a whole.

To get a complete picture of sales and demand, we need to collect various data: shelf space, product quantity, product name, product photo, planogram matrix. All this information comes from different places and usually in different formats. In order to work with them, you need to bring them together. Traditional data integration methods are mainly based on the ETL process: extract, transform and load. Data is extracted from sources, cleaned and loaded into a repository. The specialized tools of the Big Data ecosystem also have their own approach to data extraction, transformation and loading. Once integrated, big data undergoes further processing: analysis, etc. The system looks like this: data is extracted, cleaned and processed, placed in the company's data warehouse, and then exported for analysis. Figure 1 illustrates this scheme.
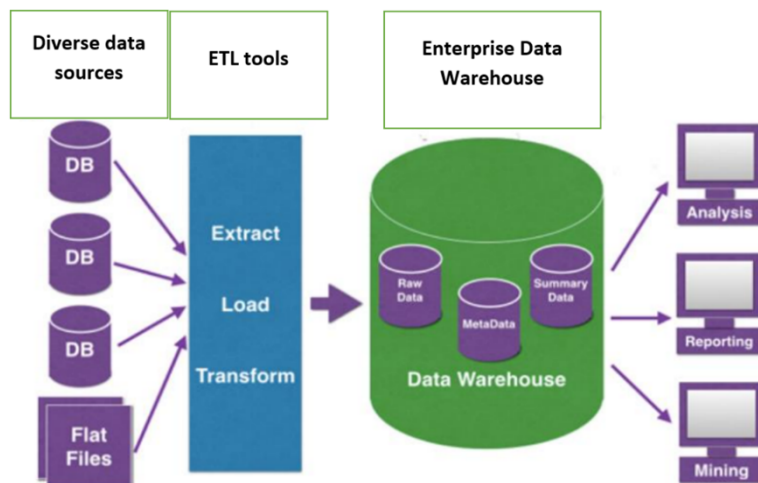

Fig. 1. Big Data processing

After training and testing, it can be used to process large amounts of data. Figure 2 shows how a simple neural network looks like: information is input to the input layer, processed inside and the result is output through the output layer.
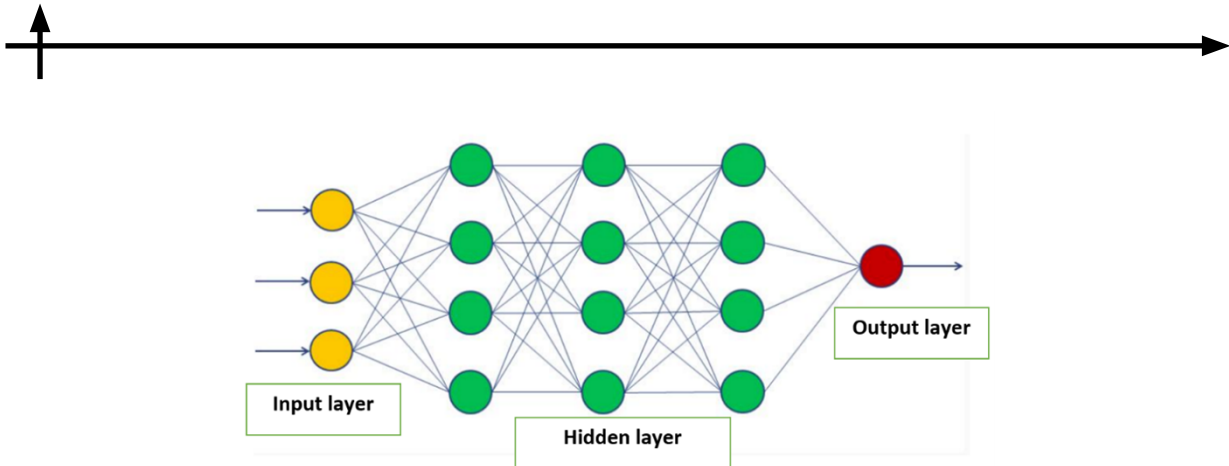
Fig. 2. Simple neural network

In order to solve the set tasks and achieve the main goal of the study, two programs available on the market were chosen: Let's consider them in detail by analyzing them. The first available program is EasyMerch - a business automation system for companies mainly in FMCG, but also in other areas (telecommunications, household appliances, pump and water filtration systems, medical products, stationery, etc.). EasyMerch is a unique tool for work: field employees (merchandisers, sales representatives, sales consultants, auditors, etc.) are provided with a full-fledged tool for daily work, and management staff - a reliable way of control. EasyMerch system structure. Mobile application for field employees - filling in reports, confirming with photos, recording geolocation and time of work at the point of sale. The app is available for iOS and Android devices and includes the following.

On-shelf product recognition - online recognition of products on the shelves by photos in the application (it is also possible to recognize products only on the web-interface after sending reports) to automate reporting on availability and shelf share, price monitoring, product location on the golden shelf, control of work performance by field employees. With online recognition, automatic addition of items in stock, filling in facings is available. Recognition for drawings, promotional images, printed materials, marketing materials, leaflets, brochures, catalogs, etc. is connected separately by individual CP. Orders - functionality of creating an order of goods through the mobile application. Support by a personal manager - database administration, individual technical support by a personal manager. Customization - individual development of additional functionality to EasyMerch according to technical specifications. Let's briefly consider the terms and conditions.

EasyMerch is developed by PRONETCOM LLC and is supplied only to legal entities under a non-exclusive license. Two weeks of demo-testing, which includes assistance in data loading, training, maintenance (Easy Merch, nd.). Monthly postpayment on the number of licenses used per calendar month. Data storage, technical support are included in the price. The second available system is iSellMore - flexible software for business process automation for trading companies of all shapes and sizes. Allows real-time tracking of field crews, sales representatives, merchandisers, couriers and managers. Provides a variety of analysis and planning tools for office staff and management.

The system aims to improve sales efficiency, productivity and agent discipline. Performance monitoring and automatic scheduling are available. The system is capable of forming an optimal scheme of covering the counterparty base and managing the personnel involved (Machine IntelligenceCity Brain Lab, nd.; NVIDIA DeepStream SDK, nd.). The automation system simplifies the work of field agents and office staff. The mobile platform allows to form any workflow with necessary restrictions and control for each agent. As the work is performed, the agent immediately sees the results of the current work, history and information about the completeness and

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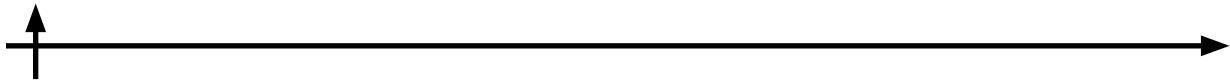
accuracy of the data entered. A web portal containing all necessary data is available to the office staff. This includes agent performance reports, scheduling and management tools, customer, employee and territory database configuration.

Key capabilities include the following:
- work with orders, balances, returns;
- detailed customer information;
- control of order history, shipments, sales, residuals, returns;
- stock balances;
- GPS tracking;
- job start and end control;
- limits;
- receivables;
- workflow planning;
- questionnaires, surveys;
- checkout control;
- price monitoring;
- presentations;
- photo reports;
- territory management;
- flexible mobile HTML reports for agents;
- integration with any accounting system;
- a wide range of operational reporting.

Assistance is provided to clients at all stages of implementation and operation of the application. It is possible to refine and fine-tune the system to meet special customer requirements. Data security from unauthorized access is guaranteed. Instant response of technical support on hotlines. The system is focused on FMCG companies' products (large number of SKUs, assortment matrices, returns, physical exchange, sales history, merchandising). The application and functionality is adaptable and customizable for the client. All functionality does not contain superfluous and is simple and clear (ABBYY FineReader Engine, nd.; Azure Cognitive Services, nd.). Technical support will solve all incoming calls, check the availability of orders with the client, consult on all issues, customize devices 7 days a week.

The development team has many years of experience in the FMCG sector. The management has substantial experience as analysts/managers in sales support departments of large FMCG companies. Has a good understanding of the changing needs of FMCG companies and are willing to tweak the system to fulfill them. There is an understanding of the working of key KPI's of FMCG companies. The company also offers to provide expert assistance in building analytical system, reporting, data collection campaigns etc.

The system allows you to build your own unique business process with its own terminology and logic like a constructor. Business processes can be arbitrary and tied to various parameters of a retail outlet/route characteristics, etc. As an example and templates of the process can be used such functions: placing orders, returns of goods; removal of balances in the point of sale; work with accounts receivable; price monitoring; audit in the point of sale (availability of goods and reasons for absence) - osa (on shelf availability), oos; fix GPS coordinates in the point of sale; take photos; participate in surveys that are created in the office; receive messages from the central office. The system allows to flexibly customize assortments in retail outlets and allows the agent to work both with a rigid visit plan and with his territory as a whole, deciding which outlets to visit and which not to visit. It is possible to download data when there is no internet or GPS access. The system stores planograms and other information about the agent's work. It

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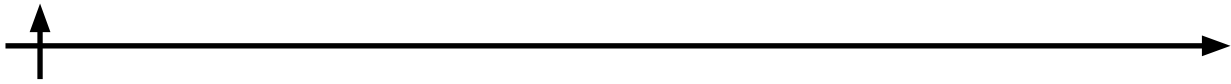
also allows you to enter and correct information about the client. There is a one-time license and payment is made for each photo taken, which is very profitable for the client.

Having analyzed these programs, the choice was made in favor of iSellMore as the most suitable tool for solving problems of FMCG companies. The system has the necessary technical properties and intuitive interface. In terms of payment, it is also a more advantageous option. A brief comparison of the systems is also presented in Table 1.

**Table 1. Comparison of EasyMerch and iSellMore systems**

EasyMerch	iSellMore
database maintenance: sales points and visit plans, routes and individual entities, availability matrices, planograms, promotions	database maintenance: sales points and visit plans, routes and individual entities, availability matrices, planograms, promotions
–	integration unit for communication with any external systems via API (1C, SAP, Magnit, Axapta, etc.) + supplementary modules
a variety of analytical reports with the possibility of scheduled uploading	a variety of analytical reports with the possibility of scheduled uploading
shelf recognition	shelf recognition, self-training of employees and coaching of subordinates, document management, orders
monthly subscription + 2 rub./photo	yearly subscription + 1.5 rub./photo
available for iOS and Android	available for iOS and Android

Conclusion

Sales force automation software, or SFA, is a solution that helps field teams do their jobs more efficiently. It's called Sales Force Automation software because sales departments were the first and are still the biggest users of this type of software, but there are other types of teams such as visual merchandisers, BTL marketers, service and support departments and many others that also use software with similar functionality. The first generation of SFA used specialized devices for field sales teams and needed to be connected to a computer at the end of the day to synchronize data. The latest solutions, however, use mobile apps for field teams and synchronize data with servers in real time using GPRS/3G/4G connections. A combination of mobile and web interfaces are used for backend and report viewing. Therefore, this study is driven by business needs.

In summary, we can say that shelf recognition technology can revolutionize merchandising. Checkout staff monitoring is becoming easier and more efficient, data and records from stores are coming online, and error rates are very much reduced. The most important thing is to keep in mind the limitations of the technology and the responsibility that each customer and supplier has to collect and provide quality input data, as well as analyze, transfer and secure the data. It can be said that in the case of IR, it is likely that the success of the project is entirely in the hands of FMCG companies. It is important for the company to understand the principles of photo recognition applications. It is necessary to control the implementation process and help the company creating the application to achieve the best results.

Without numerous tests and preparation for quality recognition, it will be very difficult to get a working system. It is also necessary to calculate the efficiency of the implemented solution and potential savings at the start of the project. After all, it may turn out that for a particular company this method will be just a way to keep up with the times, rather than improving the financial performance of the company. Working with the wrong app can increase the time a
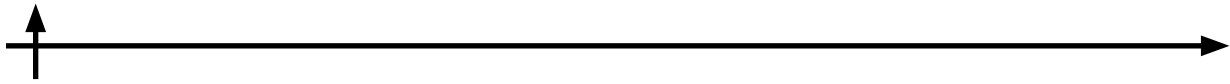
merchandiser is on a retailer's site. It's safe to say that computer vision will be a very profitable solution for companies if approached with intelligence and careful preparation.

It is possible to significantly reduce the number of hired merchandisers or transfer employees to a new position, in case of production need in the company and the feasibility of implementing exactly this kind of applications. After thoroughly scanning the image, the program saves the collected raw data and allows users to create reports with shelf analysis. A possible outcome is to empower company agents with product image recognition. For example, management can conduct store analysis at least twice as fast as before. The selected iSellMore application is a rapidly evolving SFA (Sales-Force-Automation) solution that enables customers to improve field efficiency through better routing, tasking and execution management. iSellMore is a stable IT company that has been creating software solutions for FMCG business for over 10 years. The key advantage is development of a flexible software system for automation of business processes for field-force FMCG (sales representatives, merchandisers, supervisors, etc.). The system is fully customizable to the needs of the customer company. It is a convenient tool for analyzing, planning, creating tasks and control for both line managers and top management.

Further research should pay more attention to possible disadvantages of this kind of programs. Most likely there is a possibility of cheating and bypassing the system directly by merchandisers during work - it is necessary to control the conscientious performance of employees. Nevertheless, the use of applications with artificial intelligence and image recognition in merchandising can significantly improve the sales process and increase business efficiency. Such applications can quickly and accurately analyze data, identify customer needs, and suggest the most appropriate products. Companies that will actively develop the use of such technologies will be able to gain an advantage over competitors and strengthen their position in the market.

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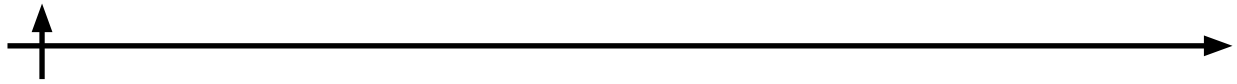
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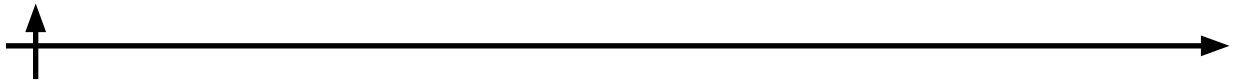
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