

## Design for Automation System for Pharmaceutical Prescription Using Arduino and Optical Character Recognition

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### Abstract

Recent healthcare environments have characteristics of expanding the scope of healthcare-impacting healthcare, complexity resulting from diversification of components, and accelerating the pace of change.

Drugs are used for the prevention, mitigation, and treatment of diseases, so they can inevitably cause harm, while they have efficacy and effectiveness, which are key elements of health recovery. Therefore, many countries regulate permits for safe and effective medicines, and also designate essential drugs directly related to life as pay targets and guarantee health insurance. Especially Pharmacist relying on manpower for composition medicine is liable for mal-manufacture due to combination of toxic medical substances or other chemical usage. In this paper, we focus on using Kiosk and Optical Character Recognition (OCR) for automated pharmacy to level up medical service and create labor friendly environment for pharmacist themselves through maintenance of prescription data and automated manufacturing solution. Presentation of drug substances and precautions will lead to efficient drug prescription and prevent misuse of information while auto manufacturing system efficiently maintain labor force and raise patient satisfaction level by reduction of waiting time.

**Keyword :** U-healthcare, Pharmaceutical Prescription , Drug safety, OCR, Arduino

### 1. Introduction

Unlike in North America where pharmaceutical company made drugs are directly supplied to patients, Europe and Korea follows the process of repackaging bulk medicines bought from Pharmacist into prescribed units. Also medical IT industries are endlessly progressing, increasing the integration of IT technology with medical field. Currently some hospitals are already harnessing IT for automated tasks and providing personal prescription in application. However most of the prescription are made manually. Problems resulted from this two factors are as following [1] [2].

In Table 1, since current manufacture process is done manually, there are limitations in manufacture

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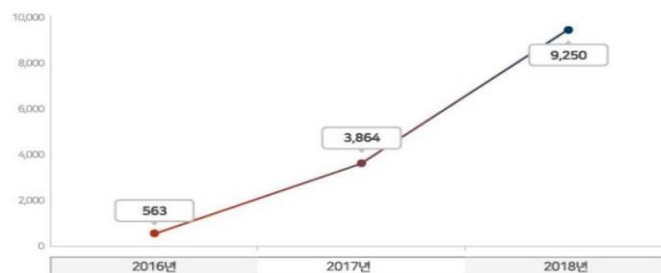
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environment and therefore negligent accidents like medicine dosage error, selection error, repackaging error could occur. In 2017 alone, 3060 patient safety accidents were recorded. Pharmacists are in danger of inhaling or being exposed to toxic drugs. Anticancer drugs with poisonous substances for skin are increasing 8% annually and anticancer pharmacies' incremental waiting time for patients is causing dissatisfaction [3][4].

**Table 1. Patient Safety Accidents(2017)**

Specification	Number of occurrences	Detail contents
Prescription	375(43.8)	Capacity error(42.4%), Duplicate prescription error(32.4%) Prescription count & days error(13.3%)
Preparation	172(20.1)	Preparation of other medications(48.3%) Capacity error(33.1%)
Medication	293(34.2)	Injection leakage(21.5%) Patient Misjudgment(19.1%)
etc	17(2.0)	Side effects of medication, Drug storage error
Total	857(100)	



**Figure 1. Number of patient safety accidents reported (2016-2018)**

As in Figure 1, it is a report on safety accidents and this table prepared based on three years of data. The number is increasing from about 560 in 2016 to 3,800 in 2017 and 9,200 in 2018. Among the statistical figures, the types of accidents were charted based on accidents related to drug use, especially in 2017.

## 2. Related Research

### 2.1 KIOSK

KIOSK is a unmanned device providing users beneficial information using voice service, implemented animation picture, GUI through advanced multimedia such as touch screen, speaker, graphics and communication card. KIOSK is used in government facilities, bank, airport, cinemas providing administrative procedure, product information, facility instruction, etc. [5][6].

As in need of cost reduction and efficient structure in spread of automated services, KIOSK is gaining popularity and therefore usability of KIOSK is getting more important. Operational principle of KIOSK is explained in Figure 2 [7]. This kiosk can be accessed using a mobile terminal, and the kiosk can select a touchscreen or NFC reader. The selected information is linked to the payment server through the seller's server, and eventually informs the user. First, it provides customized services for each department of care. All prescriptions in various patterns can be easily recognized, enabling unmanned reception and storage of prescriptions according to the characteristics of each department of care, such as pediatric, dermatology, and internal medicine. Second, like fast food restaurants, pharmacists provide an option to expose products sold in kiosks such as general medicine or non-medical products directly.

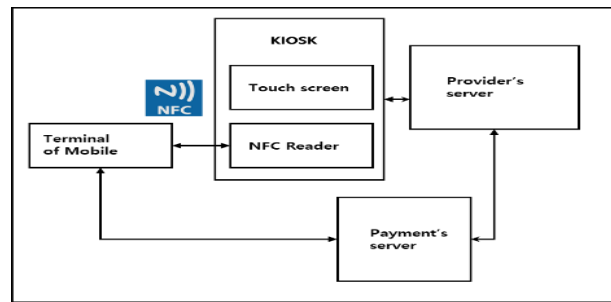


Figure 2. Example of KIOSK System Architecture

## 2.2 OCR

Optical Character Recognition(OCR) refers to recognizing characters from media and converting it into text file. OpenCV which is the most prominent opensource in image and video processing field is constructed using C++ and is also provided in JAVA and Python. OpenCV could be used in OCR for image preprocessing and Text-Localization. Tesseract is a only free opensource program that could recognize character from image format and convert it into text. Other API programs have discontinued their development or started to charge users. It provides various languages including Korean but can normally recognize single language at a time. However, in case of illegible handwriting or font and unstandardized languages, recognition is difficult [8]. As OCR advances, usefulness of OCR technology will increase as more of it gets applied to natural image processing task. Operational principle of OCR is explained through Figure 3. Processing flow is sensing and partition, image processing, feature extraction, matching.

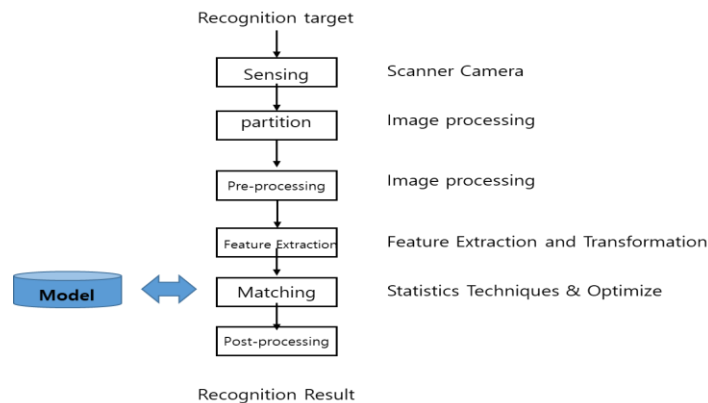


Figure 3. OCR Operational flow

- Semiconductor that converts light from camera lens into digital signal and shows image. It is a low-consumption power-type camera with CMOS structure and is being used not only for smartphones but also for digital devices such as smart TVs, medical equipment, and security systems.
- Pre-processing is Calibrating the image to make it easier for the computer to recognize areas that are text from the image.
- Character recognition is after recognizing each character as a single character, the step of understanding the meaning with a deep learning system.
- Postprocessing is the step to improve accuracy by modifying unnatural words or characters based on the content of the printed text.

### 2.3 Arduino

Arduino refers to microcomputer board and Integrated Development Environment(IDE) as a whole. Microcomputer board is a hardware while IDE is a software. Arduino microcomputer board is referred as Arduino and integrated development environment as IDE.

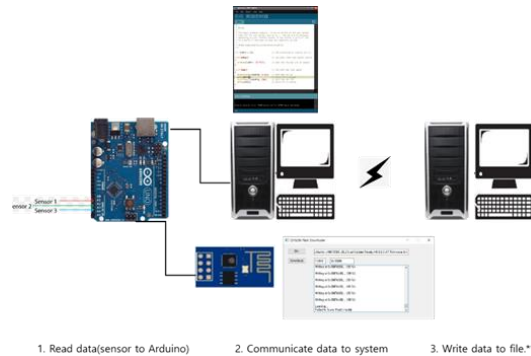


Figure 4. Arduino Usage Flowchart

In Figure 4, Electronic devices such as actuators, sensors and motors are linked on top of board for operation and IDE is used for developing programs. It functions by uploading developed program to microcomputer board, and operating microcomputer board and electronic devices as programmed. This could be found in Figure 4. IDE can also be used for serial communication with computer.

### 3. Automation of Pharmaceutical Prescription system Design

As in Figure 5, system consist of KIOSK, database and automated drug manufacture machine. First of all, KIOSK recognizes the scanned prescription. Recognized characters from prescription are then converted into text file and manufacturing machine produces necessary drugs in to unit. Simultaneously patient information and description about the drug are extracted from database to print out documents.

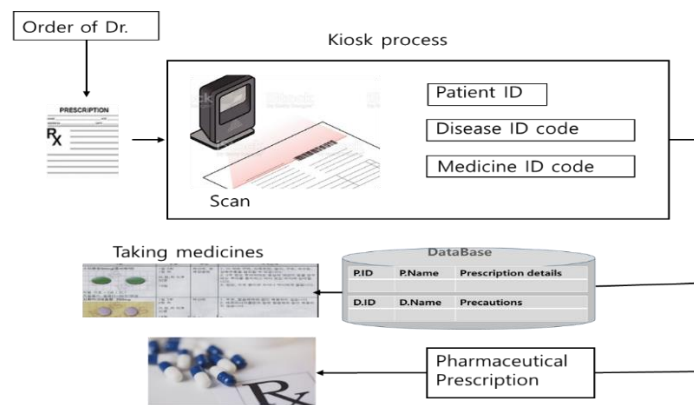
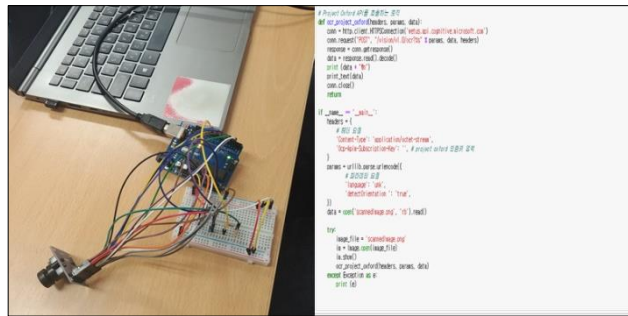


Figure 5. System Flow

### 3.1 Arduino Implementation

Arduino is used to scan prescriptions. In this paper, ESP32 board and OV7670 camera module providing VGA resolution were used, and Arduino IDE is required for software development environment. Code was implemented by JAVA and was verified through actual test. Then install camera for scanning prescription in KIOSK and recognize prescription. Afterwards character from recognized prescription is converted into text format using OCR technology.



**Figure 5. Arduino Implementation**

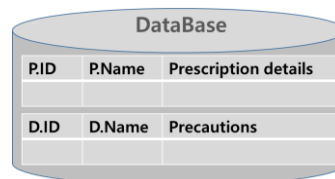
Drug information is required for two functions. They are as following. First, information is used to manufacture drugs. After verify needed drugs, that information is transmitted to medicine manufacture machine. Machine takes out verified drugs from the canister and repackage them in standard capacity. Second, information is used to search precautions and proper instruction for the pills. Verified drug information is compare with database and exported. Then exported data including additional personal precautions is printed on prepared paper to be delivered with repackaged drugs.

Patient identification code is used to identify patients and saving prescription back to database. Pharmacist can utilize database to monitor patient record and manage drug inventory.

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<http://dx.doi.org/10.7236/IJASC.2021.10.3.xx>As in Figure 6, the DB configuration was composed of a basic table for patients and a table for Drugs. The patient table can indicate the patient name, medication method, and individual patient specifications.

Social security number, name, patient identification code, necessary drug identification code, and prescribed dosage are required.



**Figure 6. DataBase Table Design**

## 4. Conclusion and Further works

In this paper, KIOSK, OCR, and automated drug manufacture machine solution are used for patient reception and analyzing prescription in order to prepare drugs with high efficiency and precision. As personnel expense and time for prescription is reduced, it is expected that pharmacy turnover rate will rise and customer

satisfaction level will improve due to shorter waiting line. Also automation will contribute to prevention of long term contact with toxic medicines and curtail erroneous incidents, cultivating pleasant and stable environment. Pharmacist could also focus more on important medication counseling. we focus on using Kiosk and Optical Character Recognition (OCR) for automated pharmacy to level up medical service and create labor friendly environment for pharmacist themselves through maintenance of prescription data and automated manufacturing solution. Presentation of drug substances and precautions will lead to efficient drug prescription and prevent misuse of information while auto manufacturing system efficiently maintain labor force and raise patient satisfaction level by reduction of waiting time.

As a future works, we would like to consider using portable equipment such as scanners as a way to reduce the burden of introducing and installing kiosk systems. In particular, currently, various problems have occurred in the process of decrypting the two-dimensional barcode, and more advanced research is being conducted. I would like to present an efficient plan considering these various methods.

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