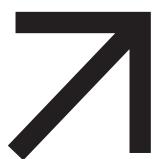




SYMPOSIUM TECHNICAL GROUP L



**Computer Sciences
and Information
Technologies (CIT)**

Web Crawling Search Prevention with Captcha

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I. INTRODUCTION

A website appears in search results based on web indexing conducted by a search engine bot (e.g., a web crawler [1]). Some web pages do not want to be indexed when they are not ready to open to the public yet. Some particular web pages may not want to be found by sensitive information such as name, email address, or phone number. There are several methods to block web crawlers from indexing a website such as a meta tag and a robots.txt file. However, such web pages can be still be indexed by web crawlers which do not conform to the defined rule. Thus, we want to determine if certain words can be made unidentifiable by web crawlers as well as if they cannot be found in log files of an application. The captcha is used to block web crawlers from entering a web site [2]. Moreover, we use captchas to hide contents by replacing sensitive words with captchas, which makes web crawlers unable to read captchas.

II. SEARCH PREVENTION ALGORITHM

We develop a search prevention algorithm and implement a web tool based on the algorithm. We start with the initial version of a conversion program that converts sensitive words in a HTML file to captcha. We replace each text letter with an image link to point to the location the captcha is stored (e.g., a web server). For example, assume that the sensitive word is ‘pray’ as in the sentence “We pray here!” as in Figure1. The sentence can be converted to the following HTML format:

```
<html>
  We &nbsp;
  <img src = "https://url/captcha/p.jpeg">
  <img src = "https://url/captcha/r.jpeg">
  <img src = "https://url/captcha/a.jpeg">
  <img src = "https://url/captcha/y.jpeg">
  &nbsp; here!
</html>
```

where ‘url’ in the http address can be replaced with a server host name.

However, we discovered if an entire word was changed to captchas letters, the word might be more susceptible to machine learning finding a series of pictures on a page. Search engine’s spelling

correction algorithms (e.g., Did you mean function in Google) may speculate the word. To prevent this, we create a novel algorithm.

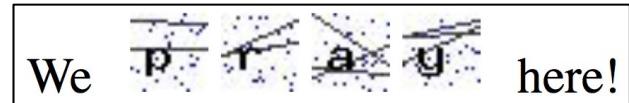


Figure 1: plain text and captcha letters on the Web

III. EXPERIMENT

To test our algorithm, we created web pages containing popular information at the time, for example, the 2018 FIFA World Cup. We created three versions of each web page such as plain text, captcha letters, and captcha phrases. The web pages have been uploaded on two different web servers (i.e., 000webhostapp and Arkansas State University). When we google with several keywords that the web pages contain. The Google search engine only could find a plain text version web page on Arkansas State University web server.

We conducted web page performance by comparing text version and captcha version. The maximum load time with captcha version is 662.2ms which is not significant based on usability engineering. We have implemented a tool to convert sensitive words into captcha letters. In addition, we have implemented a secure chat application against a search function as a proof of concept.

IV. CONCLUSION

With this algorithm, we have proven that through the use of captchas, Google’s search engine cannot find specific keywords located on web pages. As a proof of concept, search prevention can be also useful to many large companies and government agencies wishing to protect information that is published on the web.

REFERENCES

1. How Search organizes information. <https://www.google.com/search/howsearchworks/crawling-indexing/>
2. CAPTCHA: Telling Humans and Computers Apart Automatically. <http://www.captcha.net>

Improving children's perceptions toward environmental issues using the Augmented Reality as a persuasive educational tool

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ABSTRACT

This study explored the persuasive and learning effects of the Augmented Reality (AR) compared with traditional educational materials in environmental education targeting children aged 8-13 years old. Thirty children participants were recruited and divided into two groups: AR (N=16) and Book (N= 14). The changes of attitudes toward environmental issues before and after interacting with the media showed that the AR is much more effective than the book as an educational tool in the environmental education.

I. INTRODUCTION

Wildlife animals are endangered due to the human-caused activities. To manage harmful human activities, the attitudes and perceptions of people toward wildlife conservation need to be improved. This study highlighted the importance of environmental education from an early age because early perception influences the attitudes toward sustainability. In addition, it suggests the AR as the persuasion tool to change attitudes towards conservation and sustainability.

II. LITERATURE REVIEW

A. Environmental Education

Environmental education is crucial for promoting sustainable development and improving the capacity of people to address environment and development issues [1]. Although the environmental education has been continued, the general environmental knowledge of the public is still low. Expansion of the environmental education is needed.

B. Augmented Reality in Education

AR allows the users to see the real world with virtual objects superimposed upon the real world. In addition, it supplements the reality rather than completely replacing it [2]. AR is utilized as an educational tool in diverse forms: AR gaming and AR book. It is an effective tool to grab children's attention and build the student-centered learning environment.

III. EXPERIMENT

Thirty children participants (8~13 years old) were recruited through the child care center with similar

education background in environmental sciences. Participants were divided into two groups depending on media types: The AR group (N= 16) and the book group (N= 14). The experimental material was Giant panda (*Ailuropoda melanoleuca*). A total of 19 survey questions were asked: perceptions toward conservation (Q1~Q3); wildlife animals (Q4~Q8); and the new ecological paradigm (Q9~Q19).



Figure 1: Experimental setting.
The Book Group (Left) vs. AR Group (Right)

IV. RESULTS

The effect of media type on the changes of perceptions toward environment was statistically significant ($F(1, 568)= 20.5, p < 0.001$). The changes of children's attitudes toward environment were significantly different depending on the media they interacted with.

To be specific, the AR group's attitudes toward conservation (paired t-test, $p < 0.05$), wildlife animals ($p < 0.001$), and new ecological paradigm ($p < 0.001$) changed positively after interacting with the AR than before.

However, the Book group did not show statistically significant change before and after reading the book.

REFERENCES

- [1] Pooley, J.A.N.N. Environmental Education and Attitudes: Emotions and Beliefs Are what is needed. *Environ. Behav.* **2000**, *32*, 711–723.
- [2] Billinghurst, M.; Clark, A.; Lee, G. A Survey of Augmented Reality Foundations and Trends R in Human-Computer Interaction. *Found. trends human-computer interact.* **2015**, *8*, 73–272.

Gradient Descent Method for Network Interdiction Problem

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I. INTRODUCTION

Network interdiction problems (NIPs) are Stackelberg games played on a network where an interdictor (leader) seeks to impair to the greatest extent possible the operation of the network otherwise controlled by an interdictee (follower). It is often formulated as linear bilevel programs as following:

$$w^* = \min_{y \in Y \cap \{0,1\}^m} \{ \max_{x \in R_+^m} \{ r^T x \mid Nx = f, x \leq u \circ (1 - y) \} \}$$

where x is a variable that represents network flows, y is a variable that represents the interdictor's decision, r , f and u represent revenue, flow balance and flow upper-bound, respectively, and N is the node-arc incidence matrix of the network.

In our discussion, we assume that $Y = \{y \mid 1^T y \leq K\}$.

NIPs have been studied in many applications such as infectious disease control in hospitals (Assimakopoulos, 1987) and computer network monitoring (Senie and Ferguson, 1998).

There are several literatures, (Davarnia et al, 2017), (Lim and Smith, 2007), (Smith and Lim 2008), which studied the underlying structures and proposed algorithms.

II. CONTRIBUTION

In this paper, we derive an unconstrained formulation of NIPs. The objective is a non-convex piecewise linear function.

To solve the problem, a gradient descent method is proposed. We show that the number of local minima on a line is at most the number of edges. It follows that a global minimum on a line can be found in $O(K|E|^2)$ time. Thus, the exact minimization line search can be efficiently done.

We compare the performance of the proposed method with the exact method based on mathematical programming using a commercial solver (Gurobi).

REFERENCES

1. Assimakopoulos, N., "A network interdiction model for hospital infection control," *Computers in biology and medicine*, Vol. 17, No. 6, pp. 413-422, 1987.
2. Senie, D., Ferguson, P., "Network ingress filtering: Defeating denial of service attacks which employ IP source address spoofing," *Network*, 1998.
3. Davarnia, D., Richard, J.P.P., Tawarmalani, M., "On the strength and structure of KKT formulation of network interdiction problems," *Technical report*, 2017.
4. Lim, C., Smith, J.C., "Algorithms for discrete and continuous multicommodity flow network interdiction problems," *IIE Transactions*, Vol. 39, No. 1, pp. 15-26, 2007.
5. Smith, J.C., Lim, C., "Algorithms for network interdiction and fortification games," *In: pareto optimality, game theory and equilibria*, pp. 609-644, Springer, 2008.

Data Protection in the U.S.

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I. INTRODUCTION

In order to maximize corporate efficiency and profitability, data protection is quite a notable issue day by day.

From a lawyer's perspective, this article sheds light on the current data protection rules of the U.S. in comparison with the European counterparts and suggests desirable measures the companies should take for their own sake.

II. Legal Framework of Data Protection in the U.S.

A. Relevant Legislation and Competent Authorities

A-1. What is the principal data protection legislation?

The protection of data of U.S. residents is regulated by both federal and state statutes. There is no single principal data protection legislation. Federal statutes are primarily aimed at specific sectors, as explained below, while state statutes are more focused on protecting the privacy rights of individual consumers. The right to privacy is a common law right that has been incorporated into the state constitutions of many states.

A-2. Is there any other general legislation that impacts data protection?

Most states have adopted laws protecting the personally identifiable information of their residents. These laws apply to the information about a resident of the particular state and require businesses to comply with the state's laws if the business collects, holds, transfers or processes information about a state resident, even if the business does not have a physical presence or business operation in the state.

The type of information protected varies depending on the statute. Some statutes apply to any information that relates to an identifiable individual while some apply to a more limited set of personally identifiable information – an individual's name together with a data element such as a Social Security Number, driver's license number, financial account number, and medical or health information.

Not all states have enacted all such laws. Where multiple states address a specific topic, the laws in those states are not necessarily consistent with each other. Some states, such as California, are more active in protecting its consumers, restricting disclosure of personal information for marketing purposes, requiring online privacy disclosures and granting minor children the right to be forgotten in their online postings. Massachusetts, for example, has strong data protection regulations (201 CMR 1700), requiring any entity that holds, transmits or collects "personal information" of a Massachusetts resident to implement and maintain a comprehensive written data security plan addressing 12 designated activities. New York has adopted Cyber Security Regulations applicable to financial institutions doing business in the state which require comprehensive plans to address cyber security risks.

Numerous states restrict the collection of data from consumers, generally in the context of retail transactions with customers, which are done via a credit card or personal cheque.

Most states have enacted legislation that restricts recording communications involving telephones (wiretap laws) or offline (eavesdropping laws) without obtaining consent from one or all parties. These laws apply to any call initiated in or connecting to a phone in the state, and some carry criminal penalties.

A-3. Is there any sector-specific legislation that impacts data protection?

Historically, U.S. federal law has regulated data protection and consumer privacy on a sectoral basis, focusing specific regulations on financial services and health care providers. In addition, federal law imposes obligations on businesses generally to prohibit unfair or deceptive practices, to protect the intrusive use of consumer information when considering eligibility for insurance, employment or credit, and to regulate telephone, text, fax and email marketing.

The Gramm Leach Bliley Act (15 U.S. code 6802(a) *et seq.*) governs the protection of personal information in the hands of banks, insurance companies and other companies in the financial service industry. This statute addresses “Non-Public Personal Information” (“NPI”) which includes any information that a financial service company collects from its customers in connection with the provision of its services. It requires financial service companies to secure NPI, restrict disclosure and use of NPI and notifies customers when NPI is improperly exposed to unauthorized persons.

The Health Information Portability and Accountability Act (“HIPPA”) (29 U.S. Code 1181 *et seq.*) protects information held by a covered entity that concerns health status, provision of health care or payment for health care that can be linked to an individual. Its privacy rule regulates the collection and disclosures of such information. Its Security Rule imposes requirements for securing this data.

Under the Federal Trade Commission Act (15 U.S. Code 41 *et seq.*), the U.S. Federal Trade Commission (“FTC”) is broadly empowered to bring enforcement actions to protect consumers against unfair or deceptive practices and to enforce federal privacy and data protection regulations. The FTC has taken the position that “deceptive practices” include a company’s failure to comply with its failure to provide adequate security of personal information, in addition to its use of deceptive advertising or marketing methods.

The Driver’s Privacy Protection Act of 1994 (“DPPA”) (18 U.S. Code 2721 *et seq.*) governs the privacy and disclosure of personal information gathered by state Department of Motor Vehicle. The DPPA restricts how personal information is released. The DPPA defines personal information as information that identifies a person including photographs, Social Security Number (“SSN”), Client Identification Number (“CID”), name, address (but not the five digit ZIP code), telephone number, medical information and disability information.

The Fair Credit Reporting Act, as amended by Fair and Accurate Credit Transactions Act (“FACTA”) (15 U.S. Code 1681) restricts use of information bearing on an individual’s credit worthiness, credit standing,

credit capacity, character, general reputation, personal characteristics or mode of living to determine eligibility for credit, employment or insurance. It also requires truncating credit card numbers on printed credit card receipts, requires securely destroying certain types of personal information and regulates the use of certain types of information received from affiliated companies for marketing purposes. Finally, it imposes obligations on financial institutions and creditors to institute programs that detect and respond to instances of identity theft under its Identity Theft Red Flag Rule.

The Telephone Consumer Protection Act (“TCPA”) and associated regulations regulate all calls and text messages to mobile phones and regulate calls to residential phones that are made for marketing purposes or using automated dialing systems or prerecorded messages under its Telemarketing Sales Rule.

The Video Privacy Protection Act (“VPPA”) (18 U.S. Code 2710 *et seq.*) was enacted to protect wrongful disclosure of video-tape rental or sale records or similar audio-visual materials, including online streaming.

Generally, where a federal statute covers a specific topic, the federal law preempts any similar state law on the same topic. Exceptionally, certain federal law such as the Gramm Leach Bliley Act specifies that it is not preemptive of state laws on the subject. Accordingly, some states have enacted sectoral laws similar to those federal statutes listed above, with some of those state laws being more restrictive than the federal laws.

A-4. What authorities are responsible for data protection?

At the federal level, the Federal Trade Commission (“FTC”), the Office of the Comptroller of the Currency, and the Department of Health and Human Services (“DHHS”).

B. Territorial Scope

Businesses established in other jurisdictions are subject to federal data protection laws for all US residents and also to state data protection laws, based on the state of residence of any individual

whose information the business collects, holds, transmits, processes or shares.

C. Key Principles

U.S. data protection statutes are focused generally on security of the data. As such, the European principles of transparency, lawful basis for processing, purpose limitation, data minimization, proportionality and data retention are not addressed in the statutes. It is notable that there is guidance regarding a minimum period of time in which certain documents, like employee records, must be retained, but there is not necessarily a requirement for the destruction of those records after that time has expired. This is left to a company's decision.

D. Individual Rights

E-1. Right of access to data/copies of data

Under certain circumstances, employees are entitled to receive copies of data held by employers. Under the HIPAA, individuals are entitled to request copies of medical information held by a health services provider. Under the Fair Credit Reporting Act, individuals are permitted to receive a copy of consumer report information that is maintained by a consumer reporting agency.

E-2. Right to rectification of errors

This right is not applicable in the U.S.

E-3. Right to deletion/right to be forgotten

One state (i.e. California) permits individuals to request deletion of information posted online while under the age of 18.

E-4. Right to object to processing

At the federal level, individuals are given the right to not receive certain types of calls to residential or mobile telephone numbers without express consent under the Telephone Consumer Protection Act. At the state level, individuals have the right not to have telephone calls recorded without either consent of all parties to the call or consent of one party to the call.

E-5. Right to restrict processing

This right is not applicable in the U.S.

E-6. Right to data portability

Under the HIPAA, individuals are entitled to request that medical information held by a health services provider be transferred to another health services provider.

E-7. Right to withdraw consent

Under the Telephone Consumer Protection Act, individuals are permitted to withdraw consent given to receive certain types of calls to residential or mobile telephone lines.

E-8. Right to object to marketing

Under the Telephone Consumer Protection Act, individuals must provide express written consent to receive marketing calls/texts to mobile telephone lines. California Shine the Light Act requires companies that share personal information for the recipient's direct marketing purposes to either provide an opt-out or make certain disclosures of what information is shared and with whom.

E-9. Right to complain to the relevant data protection authorities

This right is not applicable in the U.S.

III. Corporate Measures: Internal Preparation

A. Appointment of a Data Protection Officer

Certain statutes require the appointment or designation of an individual(s) who are charged with compliance with the statute. These include the Gramm Leach Bliley, HIPAA, and the Massachusetts Data Security Regulation.

C. Appointment of Processors

D. Marketing

E. Cookies

F. Restrictions on International Data Transfers

G. Whistle-blower Hotlines

H. CCTV

I. Employee Monitoring

IV. Corporate Responses to a Violation of Data Protection and Relevant Issues

A. Data Security and Data Breach

Certain federal statutes and certain individual state statutes impose an obligation to ensure security of personal information. The Federal Gramm Leach Bliley Act and HIPAA impose such requirements on financial services and health care entities, respectively. Some states impose data security obligations on any entities that collect, hold or transmit limited types of personal information.

At the federal level, data breach notification are required under the Privacy Act (applicable to federal government agencies), the Federal Information Security Management Act (applicable to federal government agencies), the Office of Management and Budget Guidance (applicable to federal government agencies), the Veterans Affairs Information Security Act (applicable to the Department of Veterans Affairs), the HIPAA (applicable to health plans, health care clearing houses, and health care providers who transmit financial and administrative transactions electronically and their business associates), the Health Information Technology for Economic and Clinical Health Act (applicable to health plans, health care clearing houses, and health care providers who transmit financial and administrative transactions electronically and their business associates), and the Gramm Leach Bliley Act (applicable to financial institutions and financial services entities).

Some state statutes require reporting of data breaches to a state agency or attorney general under certain conditions. The information to be submitted varies by state but generally includes a description of the incident, the number of individuals impacted, the types of information exposed, the timing of the incident and the discovery, actions taken to prevent future occurrences and any services offered to impacted individuals such as credit monitoring.

B. Enforcement and Sanctions

The U.S. does not have a central data protection authority. Authority to enforce is specified in the relevant statutes. Some include only federal government enforcement, some allow for federal or state government enforcement, and some allow for

enforcement through a private right of action by aggrieved consumers. Whether the sanctions are civil and/or criminal depends on the relevant statute.

The question that the data protection authority ever exercised its powers against companies established in other jurisdiction would depend on a number of factors. Still, the factors should include whether the entity is subject to the jurisdiction of the U.S. courts, the impact on U.S. commerce and the impact on U.S. residents, among other things.

C. E-discovery / Disclosure to Foreign Law

Enforcement Agencies

Companies typically respond to foreign e-discovery requests, or requests for disclosure from foreign law enforcement agencies, by processing through local courts or law enforcement.

Since (i) there is no central data protection authority, and (ii) the agencies tasked with enforcement of certain statutes also enforce non-data protection issues, there is no central repository of guidance on data protection. By way of example, the FTC has issued guidance on a variety of issues including identity theft or telemarketing. State Attorneys General have offered resources on their websites for victim of identity theft and for companies suffering data security breaches. The DHHS has issued guidance on compliance with HIPAA.

V. Trends and Developments

The FTC remains active in enforcing deceptive practices including those involving marketing and security, though not specifically in the area of data protection. The DHHS remains active in enforcing HIPAA violations. Class action lawsuits alleging improper telephone recording and text messaging remain active, particularly where the statute includes a minimum financial penalty.

REFERENCES

Music Activity Program for Elementary School Students

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SUMMARY

Most of the music used in modern society is produced by digital devices. Students in schools need to experience to make digital musics using software tools, breaking away from traditional methods of composition. In this study, we propose a music activity program for elementary school students. The proposed program helps students to experience the digital process of composing and develop creativity using various composing software tools.

I. INTRODUCTION

In this study, various software tools such as educational composition programs, recorders, and conversion tools were used to experience the digital process of composition.

What the making-music activities means in curriculum is just not intellectual understanding of the elements of music, or how to write music[1]. The key is developing creativity. Through musical creation, students can increase creativity and achieve musical growth[2].

II. DESIGNING EDUCATION PROGRAM

A. Focus of designing

First, it is designed to develop computing thinking skills. The goal of software education is improvement of computing thinking. So, we organized program including computing thinking elements. Second, it is designed to develop creativity. Students can make music through various ways. Third, students need to cooperate to make music in this curriculum. In each stage, students help each other and they learn teamwork and cooperation.

B. Making Music Activity Program

The following software curriculum is designed to foster students' creativity. And this is designed to meet the Korea National curriculum.

Table 1: Making Music Activity Program

Step	Main activities
1~2	Introduction Icebreaking with students' favorite music Becoming familiar and introduction of the software tools
3~4	Practice Imitating and transforming a music presented, that is short and easy to perform
5~6	Making music Setting up a theme by team Creating music that matches their team's theme
7	Converting Converting to playable and uploadable
8	Performance Playing and appreciating Sharing their music by uploading
9	Feedback Feedback and evaluation to each other Expressing their feeling

III. CONCLUSION

In this study, we proposed a learner-oriented making music activity by using composition programs. Students can develop creativity and experience composition process of digital music. Also this would reduce the burden of making music and increase interest. So this will allow the purpose of music education to be fulfilled and creativity enhanced.

REFERENCES

1. Changhee Kang, "The Analysis of Computer Music Activities in the Newly Published Textbooks Based on the 2007 Revised National Curriculum of the Music Education in Korea," Research in Music Pedagogy, Vol. 9, pp. 1-23, 2012.
2. Hioihm Cho, "A Study on the comprehensive music learning plans for developing creativity of young children", The Journal of Korea elementary education, Vol. 13, No. 1, pp. 115-141, 2002.

Software Education in Elementary School Makes the Smart World

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I. INTRODUCTION

In the era of the fourth industrial revolution, smart has become the most common keyword. Starting with smartphones, smartness is now becoming a basic virtue in all areas. What does it mean to be smart? It means convenience to take care of it without giving it to someone. It is a consideration that counts my heart even if you do not tell something.

It is software that is necessary to make such a smart world. By teaching software to students, we can make the world a smart one faster. The software education that can create and express the actual situation will be the basis for students to have the creativity to make a smart world.

II. Elements and contents of software education for a smart world

Such devices as a house that automatically heats when the weather gets cold, a device that gives water when the pollen soil is dry make us convenient because they work on their own when needed. We allow the software to operate these devices as needed. The software must know what conditions it will perform and when. That is, students who learn software must first analyze the conditions and circumstances of when they will perform what is necessary to create smart software.

Another thing software developers should know is using data. The software should take advantage of the collective wisdom gained from the many choices people make and should know what to choose at this moment. In other words, the software developer must analyze the data and make a wise decision. Therefore, software education that creates a smart world in the future should educate students to analyze conditions and situations and to make use of data when and what they should do. For this software training, we must teach them to use real-time sensors to understand the situation. And how to collect and use data.

Sensors allow you to leverage software that responds to real-time data. By connecting the sensor and the motion unit with Arduino or Microbit, you can make various models that can produce real situation. These software classes can be linked to maker education. Software training through a maker project with sensors and operating units will

enable students to experience smart engineering at school and build their abilities to change reality.

The following table shows the basic sensor-based maker projects that elementary school students could use.

Table 1: maker project using sensors

Sensor	Project Situation	Resolution
sound	Open the door when clapping	Setting Thresholds Servo operation
light	Turn on lights when dark	Setting Thresholds Turn on LEDs
Ultrasonic	Open the door when car come in the parking lot	Determining door opening distance Open door by servo motor
dust	Beeping when dust is heavy	Setting Thresholds Use sound buzzer
temperature	Operate heater when temperature down	Lighting work (instead of heating)



Figure 1: Maker Project Using Microbit and LED

III. Conclusion

It is desirable to give students a chance to become a young smart engineer and to realize new ideas in order to develop the ability to make a smart world for students who will be the protagonists of the future society. As the software is expanding the world of smart, it is recommended to present a maker project that enables students to implement smart functions directly through software education.

Mobile App Design for Improving of Self-management of the third grade Elementary School Students

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I. INTRODUCTION

Currently, in many elementary School of South Korea, teachers make use of Diary named 'living notebook' to develop students' Self-Management. Through self-management, students can clearly set goals for their lives. But third graders in elementary school find it difficult to how to use planner. and they are not interested in planning. Because they are still young, so they don't know the importance of planning. Furthermore, they have difficulty expressing their thoughts in many sentences.

Therefore, in this paper, we present a mobile app developed using 'App Inventor' that elementary school students are interested in and can easily and effectively manage themselves[1][2].

II. APP DESIGN

A. Direction of App Design

We set basic themes, ease of use, and direction of design. First, rather than simply having a self-management function, students have set a interesting theme named 'Treasure Hunter' so that they can motivate themselves by giving meaning.

This app is based on game format. Whenever students achieve what they plan, they can get treasure map as the level rises . In addition, since it is an app to be developed for elementary school students, it is easy to use as a simple method of operation. Next, we set 'Notice' , 'Idea note' so that students can make use of them in the classroom in various way.

B. Layout of Main Screen

The main screen background is based on 'Treasure Island' image. When students click on the 'start' button, they can navigate to a screen with a variety of menus. When they click on the 'bucket list' button,

they can write what they want to achieve for a year, which is shown in Figure 1.



Figure 1: Main screen

III. CONCLUSION

In this paper, we present self-management app named 'Treasure Hunter'. However, we found a problem that we can't apply various functions by using 'App Inventor'. Because they provide limited functions . Therefore, it is necessary to continuously upgrade the App Inventor environment. Finally, it is necessary to judge the usefulness of the app and to consider the addition of more function.

REFERENCES

1. Wee Jooyoun, "The effect of Time-management training on Elementary School Student's Self-efficacy and School Adjustment," *Graduate program in child counseling psychology graduate school of education gwangju national university of education Gwangju Korea*, 2012.
2. Hwang Sungjin, "Effect of Programming Education using App Inventor on Informatics Gifted Elementary Students' Creative Problem Solving Ability and Learning Flow", *Major in Informatics Gifted Education Graduate School of Korea National University of Education Chung-Buk*, 2015.

Data Analytics in Sport: An Investigation of Factors Contributing to Winning NBA Championships

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I. INTRODUCTION

The explosion of data has affected virtually every aspect of our lives, bringing relevance to the realm of data analytics (Berry & Linoff, 2004). Data analytics enables people to gain better knowledge and deeper understandings of many social occasions (Berry & Linoff, 2004). The sport industry is no exception. Data analytics has become an essential part of every team's decision-making process, used to gain a competitive edge in their sports (Fried & Mumcu, 2017).

During the 2017-2018 season, 30 NBA teams played a total of 1230 games and attracted more than 22 million fans to arenas, setting a new record. In addition, the number of people watching NBA broadcasts on television has reached its highest since 2008. With such attention being paid to the sport, a large amount of game data were recorded at every single game. However, with such abundant game information, fans are left to contemplate one question: *What does my team need to do well to improve its chances of winning a championship?*

The purpose of the current study is to identify key factors that contribute to winning NBA championships through data analytics.

II. METHODS

A binary logistic regression analysis was used to identify key factors that influence NBA championship outcomes. The researchers analyzed 114 NBA championship games played between 2009 and 2018 seasons. The outcomes (the dependent variable) of the games were coded as a "1" for a win and a "0" for a loss. Ten factors pertaining to the game (locations, field goal percentage, 3-point percentage, free-throw percentage, rebounds, assists, steals, shot blocks, turnovers, and personal fouls) were used as predictor variables. Game statistics were retrieved from NBA websites.

III. RESULTS

The logistic regression model was statistically significant, $\chi^2(10) = 82.085$, $p < .005$. The model explained 68.4% (Nagelkerke R^2) of the variance in

game outcomes.

Table 1. Logistic Regression on NBA Championship outcomes

	B	S.E.	Wald	df	Sig.
Locations	-1.460	.664	4.830	1	.028
FG	32.286	7.622	17.945	1	.000
3PTs	10.495	4.107	6.529	1	.011
FT	6.928	3.516	3.882	1	.055
RB	.290	.074	15.547	1	.000
Assists	-.085	.079	1.151	1	.283
steals	.284	.117	5.867	1	.015
blocks	.201	.132	2.324	1	.127
Turnovers	-.415	.118	12.487	1	.000
Fouls	.026	.072	.127	1	.721
Constant	32.744	7.349	19.850	1	.000

As presented in Table 1, the logistic regression showed that six factors (location, field goal, 3-pts shots, rebounds, steals, and turnovers) significantly influenced the game outcomes. More specifically, the location and turnovers negatively influence the outcomes, which means that home teams (coded as a "1") have a higher chance of winning games than away teams (coded as a "2"), and teams that committed fewer turnovers have a higher chance of winning games.

IV. CONCLUSION

This study used data analytics to provide valuable insights for teams, coaches, and players to increase chances of winning NBA championships. These individuals should focus on improving field goal and 3-pts shooting percentage, rebounds, and steals, and reducing turnover to win NBA championships.

REFERENCES

1. Berry, M. & Linoff, G. "Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management". Wiley Computer Publishing, 2nd Ed, 2004.
2. Fried, G., & Mumcu, C. "Sport Analytics: A Data-Driven Approach to Sport, Business, and Management". New York: Routledge, 2017.

Marketing Data Analytics: A Categorical Trend Analysis of Super Bowl Advertisements

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²City University of Seattle, WA, USA ³Center for Software Education, Kyungpook National University, Korea

I. INTRODUCTION

Data analytics has become a vital component in successful marketing. A variety of analytic techniques for data have been used to understand market trends, enhance corporative images, build customer relations, and increase sales (Költringer & Dickinger, 2016).

When developing a marketing strategy, selecting an effective advertising channel is one of the most critical steps for companies to take. Due to its popularity, the Super Bowl has been recognized as one of the most attractive advertising outlets for businesses. Over the past 5 years, four of the five most-watched TV programs in the U.S. were Super Bowls, and the average number of TV viewership of the last five Super Bowls has reached over 120 million in the United States.

Despite the fact that the analysis of advertising has become an important area in marketing, there is a dearth of studies in analyzing advertisements for premier sporting events (Kim, Cheong, & Kim, 2013). The purpose of this study is to examine the trends of advertisements for the past five Super Bowls.

II. METHODS

The researchers analyzed 265 Super Bowl advertisements from 2015 to 2019 independently. A detailed coding scheme was developed. Cohen's Kappa was used to measure inter-coder reliability. The Kappa coefficients (κ) were ranged from 0.74 (target gender) to 0.90 (product categories) and statistically significant ($p < .05$).

III. RESULTS

The descriptive statistics for the 5-year data revealed that automobile-related products were the most advertised (21.9%) followed by household products (13.2%), food (12.5%), e-business (10.6%), alcoholic beverages (10.2%), soft drink (6.8%), and financial business (6.8%). Regarding the types of advertising appeals, 77% of them used only emotional appeals, 14.7% used both emotional and rational appeals, and 8% used rational appeals. Among the emotional appeals, humor (48%) was the

most frequently used, followed by excitement (19.2%), and empathy (13.2%). In terms of the target ages, 35% advertisements were for ages 18 to 35 years, followed by for all ages (21.9%), ages 7-18 (18.5%), and ages over 35 (13.4%). For the target gender, 84.5% of the advertisements were for both genders, 10.3% for men, and 5.3% for women.

The trend analysis of product categories showed that, although automobile advertisements have appeared most frequently over the course of five years, the number has decreased each year. The number of alcoholic beverage and financial business advertisements has also decreased, whereas food and household product advertisements have increased. The trend analysis of the target age groups showed that advertisements for younger consumers have consistently increased over time. Specifically, advertisements targeting the 7-18 age group have significantly increased in number over the past 5 years. For the target gender, although there have not been significant changes, advertisements targeting female audiences have gradually risen in number.

IV. CONCLUSION

The findings of this study suggest that the trend of advertising targets has shifted to encompass more than the male adult demographic, such as children and families. One of the primary reasons for such a change is that the Super Bowl has become an event with a diverse group of viewers. It is recommended that marketers and advertising executives analyze and identify the trends of advertisements and viewer demographics over a number of years of Super Bowl to maximize the effectiveness of their advertisements

REFERENCES

1. Kim, K., Cheong, Y., & Kim, H., "Information Content of Super Bowl Commercials 2001-2009," *Journal of Marketing Communications*, Vol.18, No 4, pp. 249-264 2013.
2. Költringer, C., & Dickinger, A, "Analyzing destination branding and image from online sources: A web content mining approach," *Journal of Business Research*, Vol. 68, No 9, pp.1836–1843. 2015.

A Case Study of Unplugged Activities Using Educational Drama and Theatre as an Instructional Method for Kindergarten Education

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SUMMARY

This study explored the possibility of using drama/theatre as an instructional method that can be applied to a variety of unplugged activities. Since 2015, the Kyungpook National University Software Education Center has invited kindergarten students every year to introduce unplugged activities in the form of educational plays. This drama/theatre resulted in providing an easy, fun and immersive experience and developing the concept of computational thinking for kindergarten students.

This play follows the Theater In Education (TIE) scheme, which was started in 1955 by Gordon Vallins of Great Britain. Because the TIE uses curriculum materials and social issues as themes of the drama, performances are planned and prepared by teachers and professional actors. They work closely with students regarding the topics discussed in the play. During and after the play, the audience are asked to participate in discussing the issues raised and assessing the outcomes of the play. [1].

Educational theater has recently been explored as a method for unplugged coding education in the context of computational thinking. In order to make unplugged coding education into a drama that suits for kindergarten students, a play-based workshop called "*Alpha Go's Virus-related Uproar*" was created and performed by a theater company "Saipumba". This workshop was a logical and analytical presentation of the process of dressing, cooking, or computer virus infection through the two main play characters, 'Danmi' and 'Jena'.

In order for the kindergarten students to identify and solve problems, the performers set up a process diagram, which illustrated the concepts of the unplugged activities, on the stage. The children were asked to solve the problems by using arrows and pictures.



Figure 1. The leaflet of a play-based workshop

This study was conducted to explore the use of an unplugged activity as an instructional method for kindergarten students. The results showed that the majority of kindergarten students who participated in this study developed co-organizing learning, which refers to the process of gaining experiences through a variety of unplugged activities [2].



Figure 2. Co-organizing learning experience during educational plays of unplugged activities

REFERENCES

1. Jackson, T. (1993). Learning through theatre: new perspectives on theatre in education (2nd. Ed.). London: Routledge.
2. Kim, K. (2007) Characteristics of experiential learning during co-organizing learning. The Korean Society for the Study of Lifelong Education, V13, 2nd Ed. p49-74.

Marketing Data Analytics: A Categorical Trend Analysis of Super Bowl Advertisements

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REFERENCES

1. Kim, K., Cheong, Y., & Kim, H., "Information Content of Super Bowl Commercials 2001-2009," *Journal of Marketing Communications*, Vol.18, No 4, pp. 249-264 2013.
2. Költringer, C., & Dickinger, A, "Analyzing destination branding and image from online sources: A web content mining approach," *Journal of Business Research*, Vol. 68, No 9, pp.1836–1843. 2015.

Software Architecture Analysis of Serverless Development

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I. MOTIVATION

Amazon cloud technology, Amazon Web Services (AWS), which was launched in 2006, brought the “X as a Service” concept to Information Technology (IT) community such as Software as Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). After 8 years later, the advent of serverless development of AWS Lambda in 2014 allows software developers to focus on development, not Information Technology (IT) operations - server administration. Serverless development in a cloud adds two more service paradigms to the list, Backend as a Service (BaaS) and Function as a Service (FaaS) (Roberts, 2018). However, there are no researches on how a given legacy system can be modernized to a target system using BaaS/FaaS and how software architecture the legacy system is affected.

IV. RELATED WORK

Chung et al. (2009) proposed how to identify candidate services when a service-oriented computing is used. Although cloud computing was available at that time, the service deployment was only possible with PaaS and IaaS, neither BaaS nor FaaS. For service invocation, SOAP, not REST, was used for their experiment.

II. PURPOSE AND PROBLEM STATEMENT

The purpose of this research is to discover relationships between software architecture and serverless development. For this purpose, we challenge a question – if we reengineer a legacy system, which was not developed by using the serverless computing, to its corresponding target system using the serverless computing paradigm, how will software architecture will be impacted?

III. APPROACH

A legacy system using Model-View-Controller (MVC) architecture, which is a simple Java console application, is chosen for analysis purpose. We first modernize the legacy system to a target one using AWS. Second, we model software architecture of each system in UML. For documenting software

architecture of each implemented system, we use 5W1H Re-Doc methodology with five different views – use case, static design, dynamic design, implementation, and deployment. Third, we compare and analyze two software architectures and explain how software architecture of the legacy system was changed and which architectural components were impacted. Figure 1 shows the deployed target system: its web application on the local machine and the “payroll-java-example-dev-payroll-controller” service in the AWS.

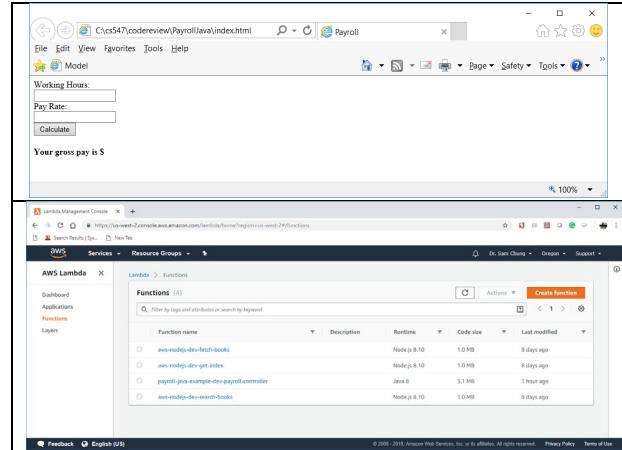


Figure 1: The Target System with a AWS Lambda

V. CONCLUSION

Serverless development does not affect the Model component. Its whole component is executed in a serverless computing environment without any modifications. Although the View and Controller components are affected, these changes are necessary due to web and cloud technologies, not because of serverless development.

REFERENCES

1. Chung, S., Won, D., Baeg, S. H., & Park, S. (2009, January). Service-oriented reverse reengineering: 5W1H model-driven re-documentation and candidate services identification. In *2009 IEEE International Conference on Service-Oriented Computing and Applications (SOCA)* (pp. 1-6). IEEE.
2. Roberts, M. (2018, May 22). *Serverless Architectures*. Retrieved from <https://martinfowler.com/articles/serverless.html>

Hacktion: Building a More Cyberliterate Public Through Public Play

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I. INTRODUCTION

Hacktion is a pervasive mixed-reality (PMR) mobile game that seeks to inform and educate the general public about cybersecurity measures in order to better protect American society from large scale cyberattacks. As a PMR game, *Hacktion* is at the forefront of games-based intervention in education and civic engagement.

II. KEY INNOVATIONS

A. Improving Game-Based Education

Hacktion is the product of a unique design in which learning objectives are built directly into the game experience rather than grafted on. The model follows Bogost, who argues that a successful educational game must integrate its rules with its fiction to be effectively immersive and intrinsically motivating.^{1,2}

B. Human Behavior in Cybersecurity

While it is tempting to think about network security as a matter of objective elements such as the resilience of data structures, our research suggests that cyberliteracy of key personnel and populations within targeted systems is far more significant^{3,4}. *Hacktion* aims to inoculate the American population from likely future hacking incidents such as DDOS and other IOT attacks.

C. Public Playtesting

During a period of open playtesting, *Hacktion* will gather in-game analytics as well as pre-and-post game surveys so we can evaluate the change in our player's knowledge of cybersecurity practices and confidence in cyberliteracy. Further, we will use customized analytical tools to evaluate game progress with a level of granularity specific to our game experience. We can, for example, isolate a group of players that only completed three of the seven mini-games and evaluate how their understanding of a given cybersecurity principle differs from the control group.

III. SCREEN SHOT

PMR games like *Hacktion* and *Pokemon GO!* use GPS and high-speed wireless networks to create public play experiences outdoors. Here, a tester plays a minigame that teaches users the importance of strong password management.

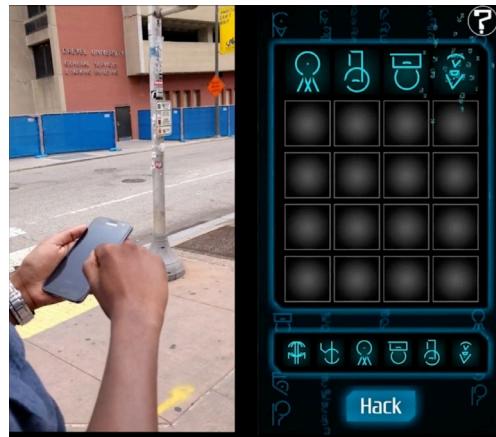


Figure 1: Pass-Cracker Minigame

ACKNOWLEDGEMENTS

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REFERENCES

1. Bogost, "The Rhetoric of Video Games." In K. Salen Tekinbaş (Ed.), *The Ecology of Games: Connecting Youth, Games and Learning*. Cambridge, MA. MIT Press. [PDF]. Retrieved Nov. 20, 2017.
2. Bogost, *Persuasive Games: The Expressive Power of Video Games*, Cambridge, Mass: MIT Press, 2010.
3. National Science and Technology Council, "Federal Cybersecurity Research and Development Strategic Plan: Ensuring Prosperity and National Security," [PDF], 2016.
4. IBM Global Technology Services, "IBM Security Services 2014 Cyber Security Intelligence Index," [PDF] 2014.

Opportunities and Challenges of IoT-based OCC in eHealth

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I. INTRODUCTION

In recent times, internet of things (IoT) has conveyed substantial potentiality in electronic healthcare (eHealth) [1]. Currently, low-power radio-frequency (RF) based technologies are extensively used in eHealth. However, RF spectrum is mostly licensed and regulated. Moreover, following pitfalls can be observed using the RF-based technologies:

- Some of the medical devices are sensitive to electromagnetic radiation.
- The effect of the radiation on human health is also considerable.
- As RF-based technologies offer omnidirectional communication, the security is a matter of concern. These limitations can be mitigated using the optical spectrum. Optical camera communication (OCC) is a promising candidate in this regard [2]. OCC uses an LED array to transmit data and a camera to receive data. The LED array can be used to transmit the bio-signals to the remote monitor using a monitoring camera. This paper discusses the opportunities and possible challenges of using the IoT-based OCC system in real-time healthcare data transmission.

II. Remote Health Monitoring using OCC

A. Opportunities

OCC can be used in remote health monitoring of patients with chronic diseases. Herein, a patch-based device is utilized. The patch is attached in the patient's body. The LED array is mounted in the patch circuit. The healthcare signal is collected using a bio-sensor. The signal is then amplified and eventually go through different filters. Afterwards, an analog-to-digital converter digitalize the signal and mount it to the patch circuit. Whenever the patch collects the signal, the signal is modulated to the LED driver and transmitted to the monitoring camera. The main advantage of this technology is the possibility of utilization of existing surveillance cameras to receive the bio-signals. The received data is then sent to the medical server through a gateway, which is eventually sent to the remote monitor. The system can be implemented in both indoor and outdoor scenarios. The system can be implemented inside an ambulance, which can be one

of the significant applications of the system. The data is sent to the 5G base station using RF. Finally, the data is transmitted to the medical database, subsequently to the monitoring person.

B. Challenges

However, several challenges can be envisaged while implementing the system. The challenges are listed below:

- The patch should be built in a manner that it does not hamper the natural movement of the patients. In this regard, the size and the weight of the patch device can be a matter of concern.
- As the size of the LED is small, the communication range will be small as well. Although it won't be a serious problem for a small hospital-room scenario, the implementation of the system will be a great challenge when multiple patients will be needed to be monitored in a large room. Multiple-input multiple-output (MIMO) technique can be a solution to this problem.
- For a mobile patient, the low data rate of the OCC system can be considered as a significant problem.

III. Conclusions

In this paper, the opportunities of IoT-based OCC in healthcare signal transmission are elaborated. In addition, the discussion of the possible challenges that can be considered while implementing the system are provided. Future research will include the investigation of the implementation complexities of the system. The implementation of high-rate OCC in eHealth will also be a major future research direction.

ACKNOWLEDGEMENTS

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REFERENCES

- [1] S. M. Riazul Islam et al., "The internet of things for healthcare: A comprehensive survey," *IEEE Access*, Vol. 3, pp. 678–708, 2015.
- [2] Moh. Khalid Hasan et al., "Real-Time Healthcare Data Transmission for Remote Patient Monitoring in Patch-Based Hybrid OCC/BLE Networks," *Sensors*, Vol. 19, No. 5, p. 1208, 2019.

Building Private LoRaWAN Platform and Application Development

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I. INTRODUCTION

Due to rapid development of electronics technology, 20 billion IoT devices are expected to be deployed by 2020. To connect such a tremendous number of devices, several low power wide area (several Km range) networking technologies have been developed, one of them being LoRaWAN. It is the technology for building smart cities and disaster safe cities.

II. METHODOLOGY

A. Architecture

Figure 1 shows the basic LoRaWAN architecture. To build its whole service system, all of the components in the figure must be deployed. Except end-nodes, such components are typically provided by a few commercial service providers. Thus, users need to pay subscription fees and rely on them, but the worst is the privacy issue as they have users' data. For the applications that are necessary to keep private, or those who want/need to build private LoRaWAN Platform, a solution is necessary.

B. Prior Work

Unlike Sigfox (another LPWAN technology), anyone can build and deploy any of LoRaWAN components, which is a big advantage of using LoRaWAN. None the less, as this technology is quite new, open-source LoRaWAN platforms are very rare. Per our knowledge, there is only one such software [1], and moreover, it is not well known for US deployment.

C. Building Private LoRaWAN Platform

We have built a prototype private LoRaWAN service platform based on LoRaServer project [1]. As this is a sample prototype that will lead to a bigger project, for hardware, we have decided to use an embedded microprocessor system and a LoRa concentrator module.

The platform consists of the following software modules: a packet forwarder, a gateway bridge, a network server, an application server, an MQTT server, and a PostgreSQL. It also requires to configure their numerous parameters.

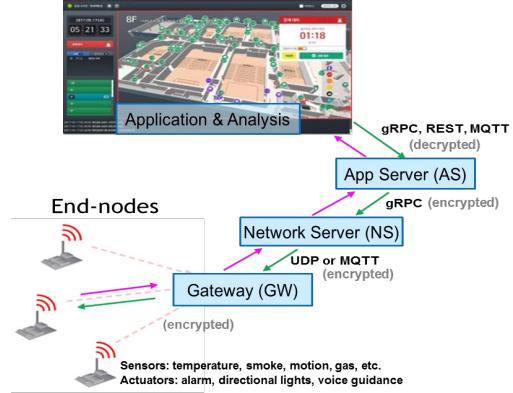


Figure 1: Platform Architecture

III. EXPERIMENTAL SETUP and RESULTS

A. EXPERIMENTAL SETUP

We have set up gateway profile and service profile, and configured the modules to abide by the US FCC regulations.

As an application, we first programmed a few sensor nodes with various sensors. For application GUI, we used Node-RED [2] tool with its Dashboard. For application data formatting, we used Cayenne LPP, which is defacto IoT data formatting standard that enables coherent data sharing among servers and applications for seamless interoperability.

We have integrated all these on a Raspberry Pi 3 with a Semtech LoRa concentrator shield.

B. EXPERIMENTAL RESULTS

We have successfully built a private LoRaWAN platform that does not require any external service providers. This platform can be used for various smart city, factory, farm applications, natural disaster prediction, infrastructure resilience and damage mitigation. It can also be easily extended to bigger platforms as more end-nodes are integrated and data are accumulated rapidly. This is possible by building separate application servers as gRPC ([3], shown in Figure 1) can communicate across LAN or Internet.

REFERENCES

1. LoRa Server, <https://www.loraserver.io/>, 2019.
2. Node-RED, <https://nodered.org/>
3. gRPC, <https://grpc.io/>

Indoor Localization and Navigation using WiFi Fine Time Measurement

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SUMMARY

This paper presents indoor localization and navigation scheme using WiFi FTM, which is a new standard that uses time of flight (TOF) and can support the sub-meter localization accuracy.

Keywords: Fine time measurement, Time of flight, Indoor localization, and Navigation.

I. INTRODUCTION

There is increasing demand for real-time tracking and routing of IoT (Internet of Things) targets within multistory structures accessible to the public such as hospitals, office buildings, warehouses, and large supply stores. Several technologies have been proposed for indoor navigation and localization services based on Wi-Fi, Bluetooth, UWB (ultra wide band), ultrasonic, or PDR (Pedestrian Dead Reckoning).

However, devices based on Wi-Fi fingerprint positioning usually have poor stability due to interference and multipath in complex surroundings inside buildings, Bluetooth suffers from limited-range positioning capability, and PDR produces accumulated errors. The localization accuracy on the order of 10 feet would not be sufficient to warrant the application in most of IoT scenarios. Recently, this technological barrier has been relieved owing to the FTM (Fine timing measurement) protocol incorporated in the IEEE 802.11 standard (802.11mc, also known as Wi-Fi Location). The measurement of time of flight (TOF) at the sub-nanosecond granularity offers more accurate localization and thus, direct relevance in numerous IoT scenarios. A great deal of interest from industry is evidenced by, for example, annual Microsoft Indoor Localization Competition (since 2016) and numerous patents filed recently by Intel, Qualcomm, Google, etc.

In this work, we employ an time-optimized FTM algorithm for IoT target's localization, and a hybrid self-adaptive technique for its navigation in indoor venues.

II. APPROACH TECHNIQUE

Our proposed indoor localization and navigation technique involves three parts. 1) An IoT target measures Wi-Fi TOF data through a grid-

oriented method. 2) Estimate the target's position through the PDR method which entails detecting the target's move and calculating the direction and stride of each move. 3) Apply the k-Nearest Neighbor (kNN) algorithm on the detected Wi-Fi TOF data, and those near the location estimated by the PDR method.

For our navigation system, a location database is designed based on the blueprints of the building floors. These data, together with the grid labels for each sampling point, are used to build a location database. To precisely estimate the target's position, the kNN algorithm is applied to check if the area from the Wi-Fi fingerprint positioning method matches the location estimated from PDR method.

This paper utilizes the WILD (Wifi Indoor Location Device) from CompuLab, which is the only commercial device available on the market for the testing of FTM as of this writing. It is a full-feature single board computer with intel Atom x7-E3950, 16GB RAM, full-fledged GNU/Linux Debian, 2.5" SSD as well as Intel Wireless-AC 8260 chipset that supports FTM.

ACKNOWLEDGEMENTS

This research was supported in part from the IoT Collaborative and the Cleveland Foundation.

REFERENCES

1. Jeon, J-P Jeong, Y-J Suh, C. Yu, D. Han, Selective AP Probing for Indoor Positioning in a Large and AP-Dense Environment, Journal of Network and Computer Application, 2017
2. S. Bak, K.-H. Jung, C. Yu and Y.-J. Suh, Guided Tour of Handoff Steering for Bandwidth in Indoor Venues, IEEE WCNC, 2015
3. K.-H. Jung, Y. Qi, C. Yu and Y.-J. Suh, Energy Efficient Wifi Tethering on a Smartphone, IEEE INFOCOM, April 2014
4. W. Wanalerlak, B. Lee, C. Yu, M. Kim, S-M. Park and W-T. Kim, Scanless Fast Handoff Technique Based on Global Path Cache for WLANs, Journal of Supercomputing, December 2013, pp. 1320-1349
5. S. Jeon, Y.-J. Suh, C. Yu, and D. Han, Fast and Accurate Wi-Fi Localization in Large-Scale Indoor Venues, 10th Int'l Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous), Tokyo, Japan, December 2013

A Method for Extending Classes by Adding a Small Amount of Data

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I. INTRODUCTION

Deep neural network has achieved tremendous results and became a necessary technology in various areas, such as classification, object detection, voice recognition and image segmentation. However, these results are always heavily influenced by the quantity and the quality of the data required for the network training process. In particular, the training of a model when a new data comes into existing data is still currently one of the more difficult processes. Also, it is more difficult to train a model if the amount of new data is not large enough to be compared with the existing data. In this paper, we have used up-sampling and examined how a handwritten digits classification model with a small amount of additional image data is well-trained.

II. EXPERIMENT

A. Dataset

This experiment requires a dataset that can easily change the number of data and be modified by itself. MNIST database (Modified National Institute of Standards and Technology) is a handwritten digits dataset that meets these conditions. MNIST database is used extensively in the image machine learning fields. The dataset contains 60,000 handwritten training images and 10,000 handwritten testing images. It includes 10 classes (0~9) and each class has about 6,000 handwritten training images.

B. Experiment

First of all, only 10% of images of class were extracted for each experiment in order to consist a small amount of data of a particular class. For example, there were 5,454 images for class number '9' in the original dataset, and 500 images, which is 10% of the class number '9', were randomly extracted. The error rate for less data had been inevitably higher than the original data. Up-sampling was chosen to reduce this error rate of a small amount of data. Up-sampling is a simple way to match when the number of classes is different. Basically, up-sampling has the concept of replicating a small amount of data to match the number of existing data. Therefore, we copied the number of

images for class number '9' from 500 to 3000 as an example.

C. Result

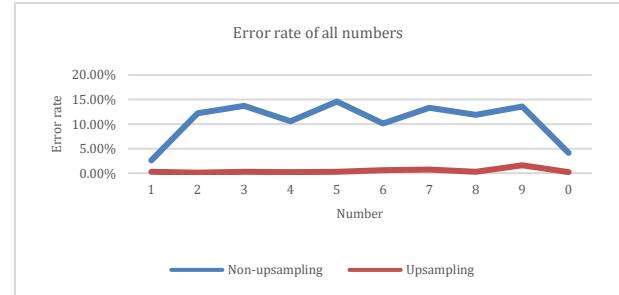


Figure 1. Error rates of each MNIST data – Blue graph represents the experiment results for each class with a small amount before up-sampling. Red graph represents the results after up-sampling.

As shown in Figure 1, the up-sampled red graph certainly has better error rates (under 2%) than the blue graph without up-sampling.

III. CONCLUSION

MNIST is the most popular image dataset for a simple deep learning test. Although it is still necessary to examine various cases, we recognized that when a new data is added to the training dataset, the upsampling method can improve the performance over non-upsampled performance. In the future, we will continue to examine various image process cases using deep learning to have better performance for a small amount of new data.

REFERENCES

1. Deng, Li. "The MNIST database of handwritten digit images for machine learning research [best of the web]." *IEEE Signal Processing Magazine* 29.6 (2012): 141-142.
2. Kussul, Ernst, and Tatiana Baidyk. "Improved method of handwritten digit recognition tested on MNIST database." *Image and Vision Computing* 22.12 (2004): 971-981.
3. Cireşan, Dan Claudiu, et al. "Deep, big, simple neural nets for handwritten digit recognition." *Neural computation* 22.12 (2010): 3207-3220.

A Study on Multi-Dimensional Textual Data for Neural Language Models

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I. INTRODUCTION

With the rapid growth of the intelligent voice assistant industry, the demands for Natural Language Understanding and Natural Language Generation have been rapidly increasing. Both of these techniques analyze natural languages spoken or written by humans that involve many ambiguities not present in formal language, thus strategies to address a degree of ambiguity are required. One of the sophisticated approaches is Language Modeling (LM). LM is a subtask of Natural Language Processing (NLP), and the process of LM seeks to build a statistical model that approximates of the probability distribution of likely subsequent contextual words of a natural language based on a given set of preceding words [1]. That is, for a sentence, the probability of the target word can be calculated as $P(W) = P(w_1, w_2, \dots, w_n)$ based on the set of preceding words w , where n is the length of words prior to W in the sentence. Recently, the emerging field of deep learning, which applies complex neural networks for machine learning tasks, has been adopted to improve all aspects of statistical data analysis, including LM. Long-Short Term Memory (LSTM), a type of recurrent neural network, is designed to process sequential data by memorizing previous input of the network, and LSTM based language models have been proposed and have obtained better performance than traditional language models [2].

Although many LSTM-based LMs have shown reasonable results, they only rely upon the analysis of words occurring in sentences without using various morphological information that can be useful as features. For example, an image is composed of three channels called RGB (Red, Green, and Blue), and these RGB-channels can be used as the features for an image analysis, indicating the color of an object. Similar to this, a sentence consists of not only words but also morphological information such as Part-of-Speech (POS) tags and lemmas. The morphological information also can be used as additional features for LM, and analyzing them can help to improve the performance of the LM. The problem, however, is

that increasing dimensions of input data added by the morphological information can cause curse of dimensionality, which interferes with training the network and negatively affects the performance of the model. Therefore, we propose a neural language model that contains a dimensionality reduction layer to compensate for the curse of dimensionality. Textual data is regarded as an n-Dimensional input, stacked with its morphological information such as the POS tag, and the proposed model reduces the dimensionality of the multi-dimensional input with a convolutional neural network [3], mitigating data loss due to the reduction. After that, an LSTM network is trained to predict the next word to generate a sentence.

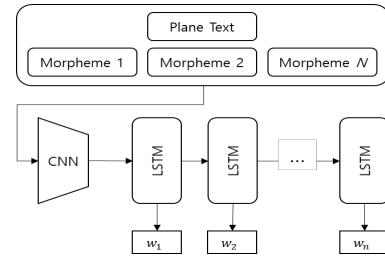


Figure 1: Architecture of proposed approach

II. CONCLUSION

Analyzing additional useful features can provide better observation of data and enhance the performance of models. In terms of variety, regarding the morphological information as additional dimensions of textual data gives us an opportunity for a better understanding of natural language.

REFERENCES

1. Bengio, Yoshua, et al. "A neural probabilistic language model", Journal of machine learning research, pp. 1137-1155, 2003.
2. Sundermeyer, M., Schlüter, R., & Ney, H., "LSTM neural networks for language modeling", In Thirteenth Annual Conference of the International Speech Communication Association, 2012.
3. Lin, M., Chen, Q., & Yan, S., "Network in network". arXiv preprint arXiv:1312.4400, 2013.

Large-scale automated error detection using artificial intelligence on dense 3D reconstructed neurons

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I. INTRODUCTION

In order to understand how the brain processes information, it is important to understand the cell's morphology and how the cells are connected. This information can be derived from a 3D stack of high-resolution electron microscopy (EM) images.

Recently, active development of reconstruction pipeline made automated reconstruction possible but machines still make mistakes. The processes can be broken (split error) or two or more cells can be merged together when the detected boundary is vague (merge error). Previously, when the dataset was small, it was possible for humans to inspect each piece to detect and fix the errors. Now we are aiming to reconstruct dataset of 1 mm³, which involves several hundred thousand cells. As we try to scale up the pipeline, it is getting nearly impossible to even find the errors because it takes enormous number of human-hours to do the task. Thus, we introduce artificial intelligence and train the network to automatically detect the errors. This can help to narrow down the scope for human proofreading or automatic error correction, which can reduce time and cost. This will supplement the pipeline to achieve accurate reconstruction to discover the brain circuit.

II. Automated Error Detector

A. Network architecture

Error detector is motivated by error detector framework by Zung et al. [1] but uses different network architecture. It utilizes modified version of U-Net [2] which takes 3D object mask and raw EM volume as inputs and outputs a 3D error map.

B. Training

EM volume of mouse primary visual cortex (V1) was densely traced by humans for the train data. Error detector is trained object by object so the input contains patch (33 x 320 x 320 voxels) of binary object mask from the machine generated output and raw EM image. The target output is the binary error map (33 x 20 x 20 voxels) computed by comparing human traced segmentation and

segmentation output by machine. As an auxiliary task, the network was also required to reconstruct the cropped object mask. This helps to add teaching signal to detect abnormality in the object shape. Flip and rotation augmentations were implemented to represent broad range of inputs.

C. Large-scale inference

To run error detector on a volume, we randomly sample the points and extract patch around that point and run inference. Object mask of that patch is marked as visited and the process is iterated until all the points in the volume are marked as visited.

To run on large-scale data, distributed inference pipeline using commercial cluster is implemented.

III. RESULTS

Error detector has been tested on a test volume, mouse V1, with ground truth segmentation. As a preliminary result, precision-recall analysis has been computed on the error detector output. With optimum threshold, it has precision of 0.85 and recall of 0.83. As it is illustrated in Figure 1, it is properly detecting the location of the error.



Figure 1 Example output of error detector detecting broken spine.

REFERENCES

- [1] Zung et al., "An Error Detection and Correction Framework for Connectomics," *Advances in NIPS*, 2017.
- [2] Ronneberger et al., "U-Net: Convolutional Networks for Biomedical Image Segmentation," *MICCAI*, 2015.

Human Gait Recognition using Kinect Depth Camera

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I. INTRODUCTION

Biometrics are widely used for a way to measure a person's physical characteristics, such as fingerprints, iris, face, voice, or behavioral characteristics [1]. Typically, such biometrics techniques require physiological and behavioral characteristics of different persons to complete a security-authentication puzzle. Unlike these biometrics, human gait can be captured with unobtrusive method by depth cameras. Thus, users are allowed to access a security authentication system without any specific actions. Using a depth camera, human gait can be measured as a model-based features. We propose dynamic and static gait features for re-identification. Each gait feature can be re-calculated by time-normalization method to be compared with other features that had different time-frames. Proposed gait features are used for classification of different walking persons.

II. Human Gait Recognition

A. 3-D Depth Data

Kinect is a depth camera provided by Microsoft for a gaming console that allows game players to control and play games with their body motion and gestures. The Kinect also provides a SDK enabling body detection and tracking of people in real-time. It is used for various of researches such as body posture, handle gesture, and human gait analysis [2]. Using extracted depth data, human body joints are extracted per gait cycle for proposed gait features. A gait cycle can be defined by several events represented in Figure 1.

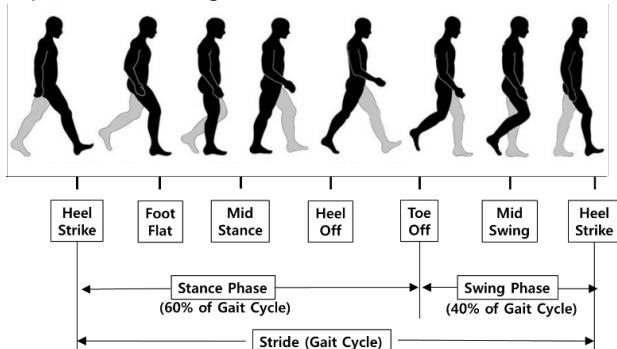


Figure 1: ABC

B. Static and Dynamic Gait Features

We propose static and dynamic signals as gait features for classifying person's gait patterns. Two types of gait features are listed in Table I. Since the static gait features are based on person's bones and movements of the body, it has little changes in the walk sequences. However, considering the features for classifying walking persons cannot clear between walking persons who have similar length of body bones and stride. Therefore, the dynamic features increase correct classification rate, because the person's walking style has various changes even though the persons have a similar body type. However, the dynamic features are unstable due to various changes of movements. Therefore, we propose a combination of both gait features to increase accuracy for gait classification.

Table 1: Gait Features from Walking Persons

Notation	Combination of Body parts	Type
S_{FRFL}	rightFoot - leftFoot	
S_{HLFL}	leftHip – leftFoot	
S_{HRFR}	rightHip – rightFoot	Static
S_{SLFL}	leftShoulder – leftFoot	(Distance)
S_{SRFR}	rightShoulder – rightFoot	
S_{HS}	Head – Spinebase	
D_{HR}	rightHip	
D_{HL}	leftHip	
D_{KR}	rightKnee	Dynamic
D_{KL}	leftKnee	(Angle)
D_{AR}	rightAnkle	
D_{AL}	leftAnkle	

REFERENCES

1. Jain, A.K., Hong, L., Pankanti, S., Bolle, R., An identity-authentication system using fingerprints. in Proceedings of the IEEE, vol.85, no.9, pp.1365-1388, Sep 1997.
2. Catalina Mocanu, IKrina Mocanu. "Human Body Posture Recognition using a Kinect Sensor", Romanian Economic Business Review, Romanian-American University, vol. 9(2), pages 325-340, 2015.

Indoor Map Matching

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Department of Geography and Geoinformation Science, George Mason University

I. INTRODUCTION

With the advance of base technology, interests in IoT and ubiquitous computing have been increasing. To realize ubiquitous computing it is necessary to maintain the current context through continuous interaction with the surrounding environment anytime and anywhere. One of the fundamental components is the spatial context. For instance, when a person walks along with sidewalk and stops at a crosswalk under a red light, we can infer that the one is going to cross the road. Surrounding spatial information, i.e., maps, and the locations on the maps enable us to conclude such inference and predict next behavior. Thus, mapping such location on maps, or map matching [1], over time is a primary step to understand the spatial context.

Unlike global positioning systems (GPS) versatiliely used in outdoor space without effort, indoor positioning systems (IPS) require complicated settings or yield erroneous positions. Moreover, different IPSs have different accuracy and adopt different location models. To track the spatial context consistent location and its model regardless of IPS are required. In this work, we introduce a unified indoor spatial model and map matching.

For the sake of uncertainty, we approach the indoor map matching problem with a stochastic model. The overall process consists of three parts: building adaptive cell location (ACL), adjusting ACL, pruning search space of possible trajectories.

II. METHODS

A. Building ACL

In this step, given location and probability distribution function (PDF), we estimate a location in a union of cells of which the area is determined by the accuracy. A cell is a space unit non-overlapped with other cells at the same level. Our hierarchical location model [2] provides adaptive locations.

B. Adjusting ACL

In the next step, we focus on reducing unnecessary uncertain region, i.e., ACL, to increase the accuracy of tracking of uncertain moving objects by mobility

constraints as shown in Figure 1. Indoor maps, distance, and mobility patterns are used in this step.

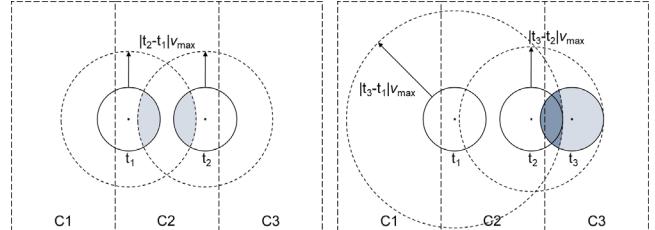


Figure 1: Tracking of uncertain moving objects

C. Pruning Search Space of Trajectories

Based on feasibility of trajectories, the most probable location at each time is determined as the result of map matching. Due to the nature of the erroneous indoor location, keeping diverse candidates of trajectories is inevitable. As time goes by, however, the number of cases of combination of trajectories exponentially increase. To avoid overhead from searching space, we employ adaptive sampling based on forward-backward-algorithm [3].

III. CHALLENGES

For providing robust and map matching mechanisms, diverse data of IPS is essential. Due to the lack of indoor maps and location data compared to outdoor space, obtaining such data is one of big challenges. While we are developing location data simulation for synthetic data generation, we will develop a framework for collecting from crowdsourcing data.

REFERENCES

1. S. Brakatsoulas, D. Pfoser, R. Salas, C. Wenk "On map-matching vehicle tracking data," Proceedings of the 31st VLDB, pp. 853-864, 2005.
2. J.-S. Kim, K.-J. Li, "Location K-anonymity in Indoor Space," Geoinformatica 20 (3), pp. 415-451, 2016.
3. J. Niedermayer, A. Züfle, T. Emrich, M. Renz, N. Mamoulis, L. Chen, H.-P. Kriegel, "Probabilistic nearest neighbor queries on uncertain moving object trajectories," Proceedings of the VLDB Endowment 7 (3), pp. 205-216, 2013.

One-round Secure Multiparty Computation with Active Security

Taeho Jung¹, Ryan Karl²

University of Notre Dame

I. INTRODUCTION

Secure multiparty computation (MPC) is a cryptographic primitive that provides data security for the applications that require joint computation among multiple parties (e.g., online auctions, voting, multi-national satellites coordination). With the Internet-of-Things and Cyber-Physical Systems, the needs of data security is rapidly growing because of the remote nature of the applications, and MPC can provide a rigorously provable security. One of the limitations is its communication round complexity. MPC protocols with one round is known to have vulnerabilities, and it is known that we need two rounds to avoid those vulnerabilities. We propose to achieve a one-round MPC protocol without those vulnerabilities by utilizing trusted hardware that is increasingly popular (e.g., Intel SGX and TPM).

II. PROBLEM DEFINITION

A. Secure Multi-party Computation (MPC)

Secure multiparty computation (MPC) is formally defined as functionality that allows a group of n parties to jointly compute $f(x_1, x_2, \dots, x_n)$ over their inputs x_i 's, while keeping those inputs private to each other. Two conditions must be satisfied: the function must be computed correctly at the end, and no information about the inputs should be disclosed at the end except the output).

B. Communication Round and NI-MPC

Communication round is defined as the minimum number of sets of parallel messages sent between parties in the protocol. For example, if during a protocol party A must wait to receive a message from party B before sending a follow-up message back to party B, it is a two-round protocol. An MPC protocol with only one communication round is called non-interactive MPC (NI-MPC).

C. Residual Function Attacks

A NI-MPC protocol must guarantee correct function evaluation. This implies that a participant with input x_i must be able to evaluate $f(x_1, \dots, x_n)$ based only on what others sent to him/her in one round (e.g., some ciphers of x_1, \dots, x_n except x_i). In other words,

a NI-MPC protocol with one round only must enable the participant to evaluate $f(x_1, \dots, x_n)$ with x_i of arbitrary values, and this in many cases enables him/her to infer others input values (e.g., f being a linear multivariate function). Such an attack is called *residual function attack*, and NI-MPC is inherently vulnerable against such attacks.

III. PEER WORK COMPARISON

[1-4] are the state-of-the-art NI-MPC protocols. They are unable to guarantee standard security against residual function attacks, therefore they define relaxed security models that allows residual function attackers. This paper proposes the first NI-MPC protocol that is secure against residual function attacks under standard security models.

IV. PRELIMINARY SOLUTIONS

Trusted platforms such as Intel SGX and TPM are equipped with secure functionality, such as remote attestation, monotonic counter, sealing and binding. We found those functions are useful in limiting the adversaries' behavior during NI-MPC protocols. For example, monotonic counter as well as sealing and binding can be used to limit the number of times of decryption to a constant number, limiting the adversaries' ability to repeatedly vary x_i in evaluating $f(x_1, \dots, x_n)$. This will effectively prevent the aforementioned residual function attacks. Furthermore, remote attestation functionality as well as General Non-interactive Oblivious Transfer enabled by trusted platforms can also achieve security against other actively malicious adversaries in NI-MPC.

REFERENCES

1. Beimel, Amos, et al. "Non-interactive secure multiparty computation." *CRYPTO*. Springer, Berlin, Heidelberg, 2014.
2. Halevi, Shai, et al. "Non-interactive multiparty computation without correlated randomness." *ASIACRYPT*. Springer, Cham, 2017.
3. Halevi, Shai, et al. "Best Possible Information-Theoretic MPC." *TCC*. Springer, Cham, 2018.
4. Halevi, Shai, et al. "Secure multiparty computation with general interaction patterns." *ITCS*. ACM, 2016.

Software-Defined Wireless Communication Toward Reliable and Energy Efficient Wireless Sensing for Space and Extreme Environments

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Reliability is the critical challenge of wireless sensing in space systems operating in extreme environments. Energy efficiency is another concern for battery powered wireless sensors. Considering the physics of wireless communications, we propose an approach called Software-Defined Wireless Communications (SDWC) that dynamically decide a reliable channel(s) avoiding unnecessary redundancy of channels, out of multiple distinct electromagnetic frequency bands such as radio and infrared frequencies. We validate the concept with Android and Raspberry Pi sensors and pseudo extreme experiments. SDWC can be utilized in many areas beyond space applications.

Indoor Map Matching

Joon-Seok Kim, Dieter Pfoser, Andreas Züfle

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I. INTRODUCTION

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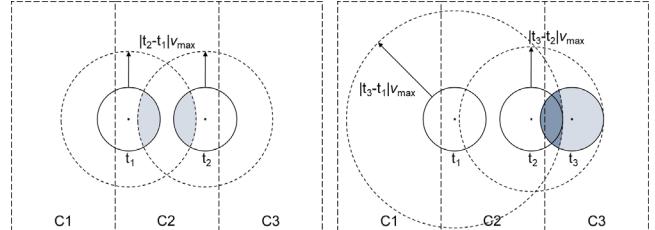


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2. J.-S. Kim, K.-J. Li, "Location K-anonymity in Indoor Space," Geoinformatica 20 (3), pp. 415-451, 2016.
3. J. Niedermayer, A. Züfle, T. Emrich, M. Renz, N. Mamoulis, L. Chen, H.-P. Kriegel, "Probabilistic nearest neighbor queries on uncertain moving object trajectories," Proceedings of the VLDB Endowment 7 (3), pp. 205-216, 2013.

Named Entity Disambiguation

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I. INTRODUCTION

Internet and social media made people's and organization's online publication prolific. The plentiful textual data includes named entities, which are instances of classes such as city, location, person, organization, country, etc. Named Entity Disambiguation (NED) is a task to clarify the semantics of each named entity in textual data. NED is accomplished by linking each named entity to an entity (or a concept) in a given knowledge base. Online knowledge bases such as YAGO [1] and DBpedia [2] are publicly available. YAGO and DBpedia contain the structural information of Wikipedia¹.

The same surface words can have different semantics depending on its usage in sentences (or in passages). For example, the passage of "I work for Apple. I want to eat apples." have two named entities: Apple and apple. They mean two different entities and need to be disambiguated for further applications such as entity search, recommendation, question/answering, etc. NED is essential for these applications as well as other applications.

II. APPROACHES

A. preprocessing

The preprocessing of entity disambiguation includes natural language processing for parsing, lemmatizing, and recognizing named entities. The process of identifying named entities from textual data is called Named Entity Recognition (NER). Once named entities are identified, named entity disambiguation (NED) process starts and consists of three stages: candidate entity generation, candidate entity ranking, and candidate entity selection as shown in figure 1.

B. Entity Candidate Generation

Entity candidates for each named entity are collected from the chosen knowledge base. For example, when Wikipedia is used as a knowledge base, each page of Wikipedia represents an entity.

Wikipedia has a disambiguation page for named entities. The disambiguation page has all possible entities corresponding to the same named entity. These entities from the disambiguation page are the main source of generating candidate entities.

C. Candidate Entity Ranking and Selection

Candidate entities for each named entity are ranked based on features. The most widely used features are (1) semantic similarities between the passages with named entities and each corresponding candidate entity, (2) the linking structure of Wikipedia web pages (i.e., entities in Wikipedia), and (3) information of user interests and/or relationships among users.

From the ranking list, the top ranked entity is linked to the given named entity, which becomes its disambiguated named entity.

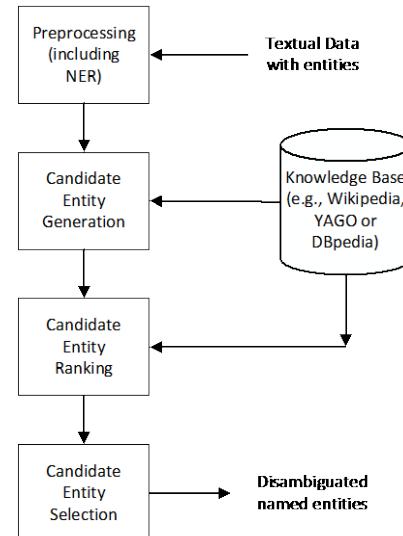


Figure 1: Named Entity Disambiguation Process

REFERENCES

1. Mahdisoltani, F., Biega, J.A., & Suchanek, F.M., "YAGO3: A Knowledge Base from Multilingual Wikipedias," *CIDR*, 2014.
2. Lehmann, J. et al., "DBpedia - A large-scale, multilingual knowledge base extracted from Wikipedia," *Semantic Web*. Vol. 6, No. 2, pp. 167-195, 2015.

¹ <https://www.wikipedia.org/>

Pathway-based Deep Clustering for Molecular Subtyping of Cancer

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I. INTRODUCTION

Cancer is a genetic disease comprising multiple subtypes that have distinct molecular characteristics and clinical features. Cancer subtyping helps in improving personalized treatment and making decision, as different cancer subtypes respond differently to the treatment. The increasing availability of cancer related genomic data provides the opportunity to identify molecular subtypes. Several unsupervised machine learning techniques have been applied on molecular data of the tumor samples to identify cancer subtypes that are genetically and clinically distinct. However, most clustering methods often fail to efficiently cluster patients due to the challenges imposed by high-throughput genomic data and its non-linearity.

II. METHODS

We propose a pathway-based deep clustering method (PACL) for molecular subtyping of cancer, which incorporates gene expression and biological pathway database to group patients into cancer subtypes. Figure 1 shows the architecture of PACL, where the nodes in the gene layer and the pathway layer correspond to biological components. The main contribution of our model is to discover high-level representations of biological data by learning complex hierarchical and nonlinear effects of pathways.

III. EXPERIMENTAL RESULTS

We compared the performance of our model with a number of benchmark clustering methods that recently have been proposed in cancer subtypes. We assessed the hypothesis that clusters (subtypes) may be associated to different survivals by logrank tests. PACL showed the lowest p-value of the logrank test against the benchmark methods. It demonstrates the patient groups clustered by PACL may correspond to subtypes which are significantly associated with distinct survival distributions. Moreover, PACL provides a solution to comprehensively identify subtypes and interpret the model in the biological pathway level.

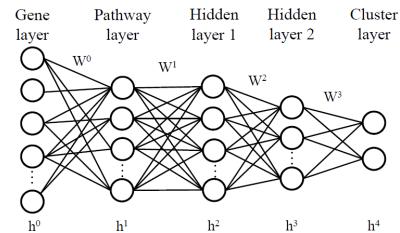


Figure 1: The architecture of PACL

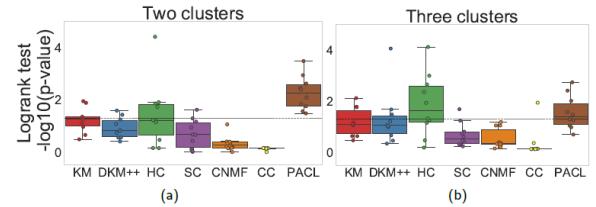


Figure 2: $-\log_{10}(p\text{-value})$ comparison of models with ovarian cancer dataset

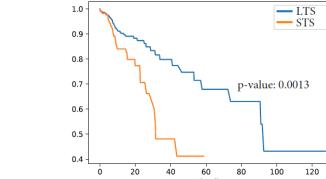


Figure 3: Kaplan-Meier survival curves of two subtypes

ACKNOWLEDGEMENTS

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REFERENCES

1. T. Mallavarapu, J. Hao, Y. Kim, J.H. Oh, **M. Kang[†]**, " Pathway-based Deep Clustering for Molecular Subtyping of Cancer", To appear in Methods
2. T. Mallavarapu, J. Hao, Y. Kim, J.H. Oh, **M. Kang[†]**, "PASCL: Pathway-based Sparse Deep Clustering for Identifying Unknown Cancer Subtypes", IEEE International Conference on Bioinformatics & Biomedicine (IEEE BIBM 2018), pp. 470-475, Madrid, Spain, 3-6 Dec. 2018

TVDP: Translational Visual Data Platform for Smart Cities

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I. INTRODUCTION

This paper proposes *Translational Visual Data Platform (TVDP)*, to collect, manage, analyze urban visual data (images/videos) which enables participating community members connected not only to enhance their individual operations but also to smartly incorporate visual data acquisition, access, analysis methods and results among them [1]. Specifically, we focus on geo-tagged visual data since location information is essential in many smart city applications and provides a fundamental connection in managing and sharing such data among collaborators while addressing the challenges of visual data platform and the proposed approaches to solve them (Fig. 1). Furthermore, our study targets for an image-based machine learning platform to prepare users for the upcoming era of machine learning (ML) and artificial intelligence (AI) applications. TVDP will be used to pilot, test, and apply various visual data-intensive applications in a collaborative way. New data, methods, and extracted knowledge from one application can be effectively translated into other applications, ultimately making visual data and analysis as a smart city infrastructure. The goal is to make value creation through visual data and their analysis as broadly available as possible, thus to make social and economic problem solving more distributed and collaborative among users. This paper reports the design and implementation of TVDP in progress and experimental results to show its feasibility.

II. TVDP PLATFORM DESIGN

As shown in Fig. 1, four core services form a cycle of data pipeline which can be applied for most data-centric applications. Using all or a part of the core services, users can utilize TVDP for their own purposes or collaboration among them. It can be as simple as quickly searching for an image (i.e., using only access), or as complex as IoT-based city-wide monitoring application with smart camera sensors (i.e., continuously using the full cycle). In particular, these core services can be used for implementing a smart city application individually or collaboratively among participants such as 1) governments: who provide an open dataset for a problem of interest, 2) professional researchers and developers: who provide algorithms and technical solutions, 3) community partners: who seamlessly act either by operating the technical solution or crowdsourcing

new data, and 4) academic partners (e.g., students): who can use the open datasets for building or extending analysis modules.

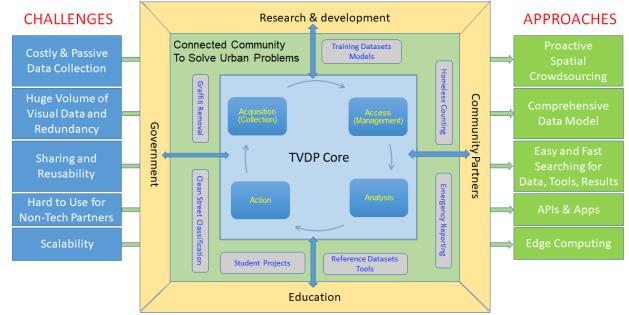


Figure 1: Overview of the TVDP Platform

III. EVALUATION

The geo-tagged images, collected by the Sanitation Department of Los Angeles, were automatically classified based on predefined cleanliness indexes and object types (such as bulky item, illegal dumping) and stored in TVDP. The same dataset was utilized for other city operations such as learning to identify graffiti. Various visual analysis can be performed on them and the results are annotated and shared, evolving into a more comprehensive and translational visual information database. We first utilized the street cleanliness classification of street images for homeless counting since one of the classification results is encampment. The resulting knowledge from one analysis for street cleanliness was translated into a useful information for another social study, i.e., homeless counting, without any extra learning processing, demonstrating that newly learned information (i.e., identification of homeless tents from geo-tagged images) can also be translated into another analysis (i.e., locations of homeless people). Intelligent representation and management of features provide smart connections among fragmented techniques into a unified visual data platform where translational data science becomes practical and easy to scale to different applications.

REFERENCES

1. Seon Ho Kim, et al, "TVDP: Translational Visual Data Platform for Smart Cities", *International Workshop on Data-Driven Smart Cities in conjunction with ICDE*, April 2019.

Speech Denoising Based on U-Shaped Neural Network

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I. INTRODUCTION

Due to the increasing need for speech enhancement applied to speech communications or automatic speech recognition, several denoising methods have been proposed, including sparsity nonnegative matrix factorization (SNMF) [1] and speech enhancement generative adversarial network (SEGAN) [2]. Recently, a U-shaped neural network (U-Net) composed of a series of convolutional neural networks (CNNs) has been popular in various areas of signal processing, especially image processing [3]. This paper proposes a U-Net-based speech denoising method for enhancing noisy speech under low signal-to-noise ratio (SNR) conditions.

II. PROPOSED METHOD

Figure 1 shows the architecture of the proposed U-Net-based speech denoising method. As shown in the figure, this architecture is composed of encoder and decoder parts. The encoder part consists of six 2D convolution layers of stride 2, where each layer is composed of kernel size 5x5, batch normalization (BN), and leaky rectified linear units (ReLU). The decoder part also consists of six 2D de-convolution layers of stride 2, which is reversely composed to the encoder. In particular, a dropout rate of 0.5 is applied only to the first three layers of the decoder part. A spectrogram of the noisy speech signal is used as the input features, while its corresponding clean speech spectrogram is used as output features. For feature extraction, the signal is divided into frames 32ms in length with 40% overlap, and a 1024-point fast Fourier transform (FFT) is applied to each frame.

In this paper, the Glorot initialization technique is utilized for weight initialization. Moreover, the mean-square-error (MSE) learning criteria between the input spectrogram and the output one multiplied by the estimated mask are used during back-propagation, which consists of an early stopper with a patience of 20. The parameters are updated in the network using the root-mean-square propagation (RMSProp) optimization.

III. PERFORMANCE EVALUATION

In order to train three different speech denoising methods including SNMF, SEGAN, and U-Net, speech and noise clips in the CHiME3 database were utilized. In other words, 7,138 speech utterances were artificially mixed with four different background noises under different SNR conditions in the range of 0-15 dB at a 5-dB step. For the

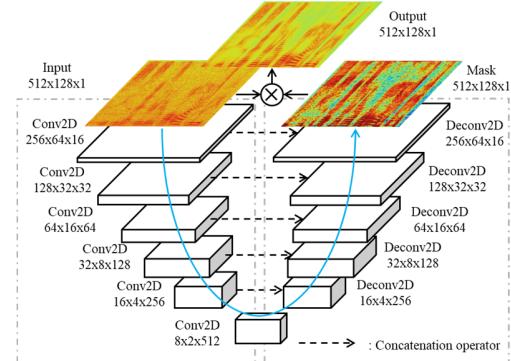


Figure 1: Architecture of the proposed speech denoising method.

Table 1: Comparison of average SAR and PESQ of different denoising methods

Method	SAR (dB)	PESQ
SNMF	17.5449	2.6718
SEGAN	15.4794	2.7252
U-Net (proposed)	21.7576	2.9181

evaluation data, 200 speech utterances from the TIMIT database were mixed with noise from the DEMAND database under the same SNR conditions as those used for training. Then, the perceptual evaluation of speech quality (PESQ) and signal-to-artifact ratio (SAR) were measured as objective measures.

Table 1 compares the objective measurements of SNMF, SEGAN, and U-Net. It was shown from the table that the proposed U-Net-based denoising method archived higher PESQ and SAR scores than the other methods.

ACKNOWLEDGEMENTS

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REFERENCES

1. K. M. Jeon and H. K. Kim, "Local sparsity based online dictionary learning for environment-adaptive speech enhancement with nonnegative matrix factorization," in *Proc. of Interspeech*, pp. 2861-2865, 2016.
2. P. Saniago *et al.*, "SEGAN: speech enhancement generative adversarial network," in *Proc. of Interspeech*, pp. 3642-3646, 2017.
3. O. Ronneberger *et al.*, "U-Net: convolutional networks for biomedical image segmentation," in *Proc. of MICCAI*, pp. 234-241, 2015.

Life-Log Monitoring for Anomaly Detection and Diagnosis based on Deep Learning

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I. INTRODUCTION

Life Log data is an important and valuable resource for understanding health status in various conditions in acute and chronic states. Analyzing life-log systems are necessary source of information for real life monitoring and anomaly detection.

The development of smart sensors seems to have an important role for creating life data and contributing to raise awareness for the health condition for maintaining a high level of wellness. Latest technologies are getting more sophisticated when come to monitoring the human daily activities. Wearable devices generate data by monitoring specific part of body and communicate among other devices. Data are stored in database in log file format for further analysis by the means of latest Deep Neural Network (DNN) techniques [1]. Log data is created for different sensor centered on wearable sensors with the purpose of diagnosing patterns of health condition and anomaly cases. In order to provide trustful knowledge from the data, we propose an analytic model, based in Recurrent Neural Network methods (RNN) that utilize Long Short - Term Memory (LSTM) units.

This work is a data-driven approach for detecting anomalies in data form daily activities with the intuition from natural language and semantic analysis. In addition, we demonstrate how different parameters and architecture choices of the DNN techniques affect the performance of the system. This study shows promising result in the improvement of the performance in the anomaly detection for Log Life data.

II. PROPOSED METHOD

Deep learning methods turns out to be as one of the most popular machine learning techniques. Recurrent Neural network [2] and Long Short-Term Memory (LSTM), analyze a system log in analogy with natural language sequence where LSTM has shown effective results. Data are collected from several devices and they are organized in a log file format, using time as the main sequencing feature. Next step, data are used to train and learn the neural network to automatically learn log patterns from

normal execution, and detect anomalies. When log patterns deviate from the model trained from log data under normal execution is the first step of our research (Figure 1). To evaluate the performance of method are used the standard metrics such as Precision, Recall and F-measure.

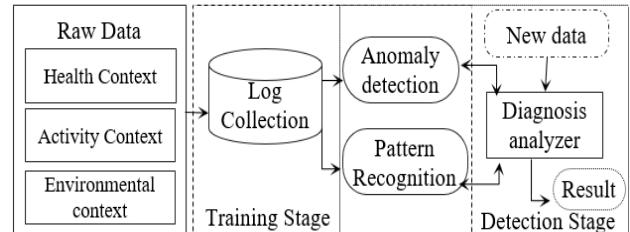


Figure 1: Conceptual model for anomaly detection

III. CONCLUSION

This paper presents a life log analysis work for anomaly detection using Recurrent Neural Network. With the purpose of anomaly detection, there are used several machine learning the plain text format data and compare with the log file format analyzed as sequential data in order to provide a successful solution. Based on the results we conclude that RNN with LSTMs are effective time series modelers and anomaly detectors.

ACKNOWLEDGEMENTS

This research was supported by the MISP (Ministry of Science, ICT & Future Planning) Korea, under the National Program for Excellence in SW, supervised by IITP (Institute of Information & Communication Technology Planning & Evaluation) (2018-0-01865)

REFERENCES

1. Du M., Li F., Zheng G., and Srikumar V. "DeepLog: Anomaly Detection and Diagnosis from System Logs through Deep Learning", In Proceedings of the 2017 ACM SIGSAC Conference on Computer and Communications Security. ACM, 1285–1298, 2017.
2. Rizk Y., and Awad M. "On extreme learning machines in sequential and time series prediction: A non-iterative and approximate training algorithm for recurrent neural networks", Neurocomputing, 325, 1–19, 2019.

Bitrate Adaptation for Mobile Video Streaming Service Based on the User Interest

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I. INTRODUCTION

In recent years, the growth of large streaming service platforms such as YouTube and Netflix has increased the proportion of video traffic on the Internet. In this environment, HTTP adaptive streaming has been proposed to improve a user QoE (Quality of Experience) of video streaming. HTTP adaptive streaming determines adaptively a bitrate to be requested for a video divided into various bitrates according to network condition [1].

However, in mobile video streaming, available bandwidth is limited due to packet loss and delay in a network. In addition, users viewing a video will focus on what are interesting parts to them [2]. Figure 1 shows changes in user interested video parts. For these parts, a user wants to experience high video quality and seamless video playback. Conventional bitrate adaptation schemes do not take into account the user interest in determining bitrate to be requested. These schemes only consider network and contents related factors such as estimated bandwidth, buffer occupancy, content characteristics, etc., resulting in the suboptimal QoE for the users.

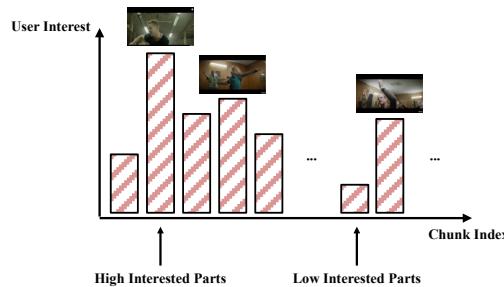


Figure 1: Changes in user interested video parts

II. METHODS

Figure 2 shows a schematic diagram of the proposed bitrate adaptation. When downloading a video chunk is finished, the proposed scheme estimates a charging rate of playback buffer using the estimated bandwidth, buffer occupancy, and chunk size. Highlights score representing the changes in the user interest is analyzed at a server in advance and

the server provides information related to the video highlights through a description file transmitted to a client after the video streaming starts. When determining the bitrate for upcoming video chunk, the proposed scheme considers the estimated buffer charging rate to minimize playback interruption and allocates the bandwidth differently according to the highlights score of each video chunk. The performance of proposed scheme is evaluated through various experiments.

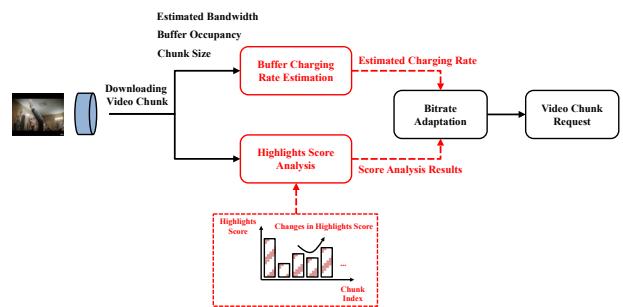


Figure 2: Schematic diagram of the proposed bitrate adaptation

ACKNOWLEDGEMENTS

This work was supported by the Institute of Information and Communications Technology Planning and Evaluation (IITP) grant funded by the Korean Government (MSIT) (Development of the System to Analyze and Detect the Obscenity in Media Contents Utilizing Artificial Intelligence Technologies) under Grant 2019-0-00287.

REFERENCES

1. A. Bentaleb, B. Taani, A.C. Begen, C. Timmerer, and R. Zimmermann, "A Survey on Bitrate Adaptation Scheme for Streaming Media over HTTP," *IEEE Communications Surveys & Tutorials*, Vol. 21, No. 1, pp. 562-585, 2018.
2. G. Gao, H. Zhang, H. Hu, Y. Wen, J. Cai, C. Luo, and W. Zeng, "Optimizing Quality of Experience for Adaptive Bitrate Streaming via Viewer Interest Inference," *IEEE Transactions on Multimedia*, Vol. 20, No. 12, pp. 3399-3413, 2018.

Cloud-Based Security Service System for User's Security Intent Support

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I. INTRODUCTION

Nowadays, cloud-based services have been popularly provided to the Internet users. For these cloud-based services, security services need to be provided accordingly against well-known or new security attacks. This paper proposes a cloud-based security service system supporting a user's security intent. When a user specifies his high-level security policy, the security service system needs to understand it, and then enforces the corresponding low-level security service such as firewall, deep packet inspection, data loss prevention, distributed denial of service (DDoS) attack mitigation. Our cloud-based security service system can grasp a user's security intent, so it can provide him with the intended security services automatically by selecting appropriate network security functions (NSF) in a network functions virtualization (NFV) environment and software-defined networking (SDN) networks.

II. CLOUD-BASED SECURITY SERVICE SYSTEM

A. Interface to Network Security Functions (I2NSF)
Internet Engineering Task Force (IETF) Interface to Network Security Functions (I2NSF) working group is working for standard interfaces of cloud-based security service systems. Fig. 1 shows an I2NSF security service system whose main components are I2NSF User, Security Controller, Developer's Management System, and NSFs. In Table 1, I2NSF interfaces are listed up along with their control protocol. Developer's Management System registers its NSF into Security Controller with its capability information via Registration Interface.

B. Intent-Based Security Service System

I2NSF User (as a network administrator or a customer) can specify a high-level security policy, and deliver it to Security Controller via Consumer-Facing Interface. Security Controller translates the high-level security policy into the corresponding low-level security policy with its policy translator. The low-level security policy will be delivered to an appropriate NSF which configures the policy in its local repository for security enforcement. Both the

high-level and low-level security policies can be described in XML files for RESTCONF or NETCONF though YANG data models for each I2NSF interface in Table 1. Thus, the I2NSF security service system in Fig. 1 can autonomously provide a user with security services for the user's security intent.

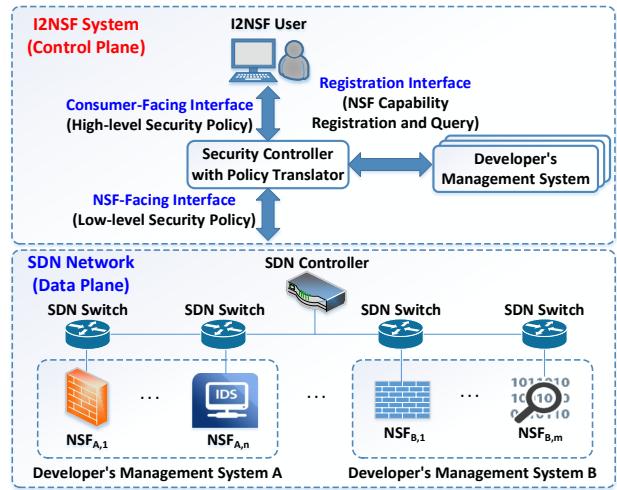


Figure 1: I2NSF Security Service System

Table 1: I2NSF Interface and Control Protocol

I2NSF Interface	Control Protocol
Consumer-Facing Interface	RESTCONF
NSF-Facing Interface	NETCONF
Registration Interface	NETCONF

ACKNOWLEDGMENT

This work was supported by Institute for Information & communications Technology Promotion (IITP) grant funded by the Korea government (MSIP) (No.R-20160222-002755).

REFERENCES

1. S. Hyun et al., "Interface to Network Security Functions for Cloud-Based Security Services", IEEE Communications Magazine, Vol. 56, Issue 1, January 2018.
2. Sungkyunkwan University, "I2NSF Open Source Project", <https://github.com/kimjinyong/i2nsf-framework>

Blockchain-Based Social Media Sharing System for Public Utility

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I. INTRODUCTION

This paper proposes a blockchain-based social media sharing system for improving public utility [1][2]. This system encourages people to voluntarily be engaged in social media generation for sharing multimedia data (e.g., text messages, video clips, audio files, and photo/picture files) about safety and entertainment for welfare in public places. This system can store and share those data in a blockchain through both social networking service (SNS) websites (e.g., Steemit) for entertainment and government portal websites for public safety. For the active engagement of people, this system provides incentives to both data providers and blockchain-operation participants (e.g., transaction validation).

II. A BLOCKCHAIN BASED SHARING SYSTEM

A. Problems of Conventional Systems

Conventional systems for public utility has three major problems such as (i) significant waste of time and resources, (ii) limited information, and (iii) infeasibility of the proof of information.

B. Social Media Sharing System

In our proposed medial sharing system, users can create media files through in-app camera and upload them to a SNS website (e.g., Steemit) through our blockchain. Each file is treated as a transaction and is added into a block in chronological order. Participants receive incentive points from the SNS website. On the other hand, if a post receives downvotes due to malicious contents, a user will be added to a black list for post restriction as a penalty.

C. Structure of a Transaction

In our system, a transaction consists of type (e.g., video, picture, and text), title about media data, the description of media data, the URL to link to contents file (to minimize the size of a transaction), anonymous user identifier (User ID) for identifying a source provider and incentive granting [2]. A media data provider uploads the contents file (e.g., video, audio, photo, and text) into his cloud servers (e.g., Dropbox and Google Drive) and provides the URL link to the file to allow others to access it.

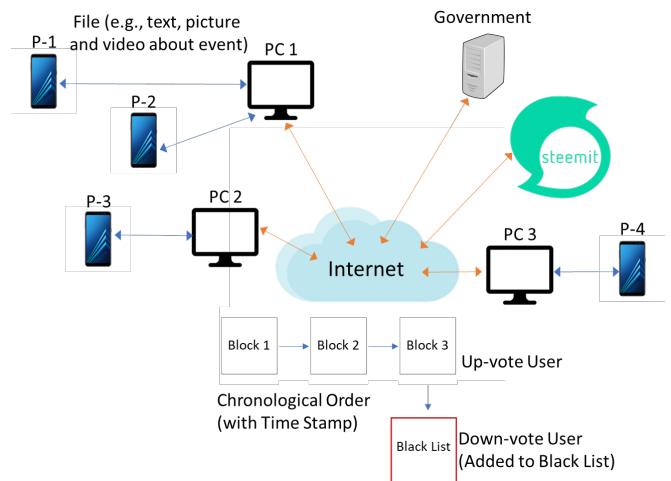


Figure 1: Social Media Sharing System

D. Registration of Transaction

Fig. 1 shows our social media sharing system. A user uploads a media file with his smartphone into a proxy personal computer (PC) as a blockchain full node. In Fig. 1, a media provider P-1 sends its transaction to a blockchain proxy PC1. PC1 creates a transaction block with the user's media file and its associated information. It also signs the block through digital signature along with its private key and sends it to the blockchain community for transaction distribution.

E. Incentive System

Our system adopts a voting-based incentive system. This incentive system differentiates a useful transaction and a malicious transaction with an up-voted transaction block and a down-vote transaction block, respectively. For the up-voted transaction, the system gives the media provider an incentive. On the other hand, for the down-voted transaction, it adds it to a black list and restricts its post as a penalty.

REFERENCES

1. Satoshi Nakamoto, "Bitcoin: A Peer-to-Peer Electronic Cash System", Cryptography Mailing list at <https://metzdowd.com>, 2009.
2. Y. Jeong and H. Kim, "A Blockchain-Based Social Media Sharing System for Public Welfare", KICS Fall 2018, November 2018.

A Development of Human Image Recognition Method based on Directional Histogram to Support Predictive Maintenance

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I. INTRODUCTION

Basically, smart factories monitor work environments through IoT sensor devices and cameras to support predictive maintenance. However, despite the recent support of predictive maintenance services, worker infections due to gas leakage frequently occur within the smart factory. There is also an explosion in the handling of gas and hazardous materials by non-experts placed in the workplace. This is an accident caused by a factory worker rather than a machine defect. In order to solve this problem, it is necessary to strengthen the predictive maintenance service through operator image recognition. In particular, it is necessary to support predictive maintenance by monitoring the area where the manager can't intuitively handle using the local PC.

Therefore, in this study, we propose a method to extract human from camera images through deep learning based on directional histogram in order to support predictive maintenance service. Particularly, the proposed method combines the techniques of [1], [2], and [3] to detect people within 5 seconds through real-time processing.

II. PROPOSED METHOD

In order to develop human image recognition method based on directional histogram, the main PC and 16 cameras were configured as interfaces. Instead of detecting an object using a single channel image characteristic, a method [1] of calculating various channels for a detection target region is applied. Especially, it is possible to detect even if the shape of object changes in real time by using part-based detection method [2] which can detect not only whole body but also part of body. Moreover, we combine [3] technique to detect rapidly without changing the size of the image in order to detect objects of various sizes.

In order to develop the proposed algorithm and to make the experiment, we first designed the system configuration and edited the commercial data set (COCO) and then learned it with GPU. In particular, to make sure that the program works properly on the web, 15 GB of learning data is learned through a learning machine as shown in Figure 1.

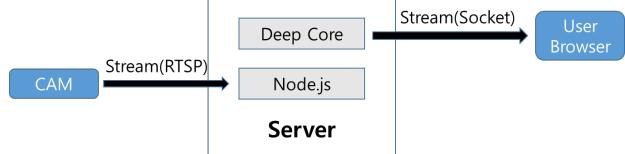


Figure 1: Structure for running on the Web

The test was carried out in real time through the IP camera, and based on the learning data, the person was found in real time on the input image. It was able to judge a person accurately with only a part of a person as well as a lot of people.

III. CONCLUSION

In this study, we proposed and developed a human image recognition method to recognize workers in a smart factory. As a result of the experiment, we detected workers within 5 seconds of detection time. After detecting the worker, the worker is recognized through the alarm function and the recording function. It is expected that the proposed and developed method will be useful for the intelligent predictive maintenance monitoring service in smart factory.

ACKNOWLEDGEMENTS

This research was supported by the MISP (Ministry of Science, ICT & Future Planning) Korea, under the National Program for Excellence in SW, supervised by IITP (Institute of Information & Communication Technology Planning & Evaluation) (2018-0-01865)

REFERENCES

1. P. Dollar, Z. Tu, P. Persona, and S. Beloglie, "Integral channel features," in Proceedings of the British Machine Vision Conference. BMVC Press, London, pp. 91. 1-11, 2009.
2. P. F. Felzenszwalb, R. B. Girshick, D. McAllester, and D. Ramanan, "Object Detection with Discriminatively Trained Part-Based Models", IEEE Transactions on Pattern Recognition, Vol. 32, No. 9, pp. 1627–1645, 2010.
3. R. Benenson, M. Mathias, R. Timofte, and L. V. Gool, "Pedestrian detection at 100 frames per second", IEEE Conference on Computer Vision and Pattern Recognition. CVPR 2012, pp. 2903-2910, 2012

Anomaly Detection and Response Framework based on Network traffic and Hardware Information of IoT Devices

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I. INTRODUCTION

The IoT industry is growing rapidly, but attacks such as the Mirai malicious code are being attempted on IoT devices with weak security. These attacks currently cause massive socio-economic losses, with global economic losses from cybercrime reaching about USD 400 billion annually [1].

In this paper, we extract hardware information from IoT devices that have limited resources and examine a method to detect and respond to anomalies using the extracted hardware information.

II. METHODOLOGY

We propose a methodology for security technology which can detect and respond to anomalies using hardware information and network information collected from low-weight IoT devices.

A. Information collection system

It is collected using port mirroring technology to replicate the network information. In addition, the items (CPU, memory, disk, network information) in Table 1 are collected from the client group and utilized in the analysis using the basic commands and hardware information collection tools provided by the IoT devices. If the basic commands provided by IoT devices are used, they can be used in low-weight IoT equipment because monitoring functions can be performed without installing any additional equipment.

Table 1: Collected Hardware Information

Extracted	Classification
Basic specs	CPU, Memory, Disc
Usage levels	CPU, Memory
Process list	Memory
Utilization	Network, Disc
Idle time	CPU
Occupancy process	CPU

B. Anomaly Detection and Response

An anomaly detection system based on hardware information and network information selects and

extracts items that are highly associated with anomalies through basic commands and port mirroring of IoT devices. As shown in Figure 1, low-weight anomaly detection is performed through correlation analysis based on the selectively extracted data. It is collected using port mirroring technology to replicate the network information.

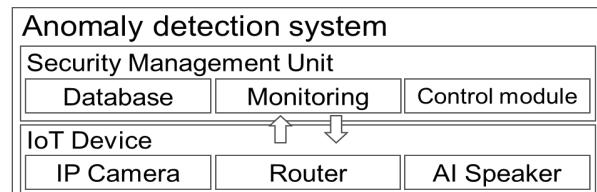


Figure 1: Structure of an anomaly detection system

The collected hardware and network information are divided into before and after the infection of malicious code to perform a correlation analysis between each characteristic, and the items showing the highest relevance and the highly weighted characteristics were selected to detect. Finally, the Security management unit sends control commands (Power On/Off, etc.) to the IoT device to respond to the detected anomaly.

III. CONCLUSION

Hardware information was extracted using basic commands provided in a IoT environment, and correlation analysis were performed using network information. We plan to implement an anomaly detection framework for IoT devices that are actually used based on collected and analyzed hardware and network information.

ACKNOWLEDGEMENTS

This work was supported by Institute of Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea government(MSIT) (No.2018-0-00232, Cloud-based IoT Threat Autonomic Analysis and Response Technology)

REFERENCES

1. KOTRA, "Global Market Report 16-045", 2016

Performance Analysis of Single-node Single GPGPU and Multi-node Multiple GPGPUs

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I. INTRODUCTION

In the past, the GPU was only used for computer graphics operations. The latest GPU called GPGPU (General Purpose Graphic Processing Unit) can be used as a processor specialized for massively parallel processing as well as graphical computations [1]. As a result, GPGPU is receiving a lot of attention. GPGPU is a powerful tool for high-performance computing [2]. In this paper, we measure the time required for the convolution operation of a single-node single GPGPU and MPI-based multi-node multiple GPGPUs. We also analyze the effect of the number of nodes and GPGPUs on the computation speed.

II. EXPERIMENTS AND ITS RESULTS

A. Measurement of the Computation Time of a Single-node and Multi-nodes

We used a convolution operation to measure the performance. There are some major parameters in the convolution operation. First, the number of GPU threads used in convolution operations is 1024, which is the maximum size of the GTX 1080Ti device. Second, the number of blocks is (Output Size x Input Channel)/1024+1. Third, the numbers of size of the inputs and filters are set to the values as shown in Table 1, respectively. At last, the size of the stride is set to one. We used NVIDIA GTX 10 80Ti. Table 1 shows the results of convolution operations. (A) means the computation time of single-node single GPGPU. (B) means the computation time of multi-node with 4 GPGPUs. (C) denotes the level of the improvement(%) of B's computation time when compared to that of A.

As shown in Table 1, the performance of (A) is better than (B) in case of the input size is 2048 x 2048. This phenomenon is due to the load caused by communications among the main node and sub-nodes. The communication load occurs in the process of transmitting data from the main node to the sub-nodes and receiving the result back to the main node after the operation is finished in the sub-nodes.

When the input size is increased to 4096 X 4096, the load due to computation becomes larger than the load due to communication. Therefore, the computation time of multi-node with 4 GPGPUs is reduced by up to 74.7% when compared to that of a single node with a single GPGPU.

Table 1: Results of Convolution Operations (Unit: s)

Input Size	Filter Size	(A)	(B)	(C)
2048 x 2048	1047 x 1047	18.0	43.6	-142.8
4096 x 4096	3095 x 3095	163.4	41.3	74.7

III. Conclusion

In this paper, we measured and analyzed the impact of the Multi-node multiple GPGPUs in terms of the execution time. As the computation load increases, it is confirmed that the efficiency of multiple GPGPUs is excellent. In future works, we expect to improve the performance by optimizing the libraries used in multi-node convolution operation accelerations.

ACKNOWLEDGEMENTS

This research was supported by the MSIP(Ministry of Science, ICT & Future Planning), Korea, under the National Program for Excellence in SW)(2018-0-01865) supervised by the IITP(Institute for Information & communications Technology Promotion), and supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2017R1C1B5017476).

REFERENCES

1. Owens, John D., et al. "GPU Computing." *Proceedings of the IEEE*, pp. 879-899, 2008.
2. Luebke, David, et al. "GPGPU: General-Purpose Computation on Graphics Hardware." *Proceedings of the 2006 ACM/IEEE conference on Supercomputing*. ACM, 2006.

Recognition of Chinese Cursive Character Using Deep Learning

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I. INTRODUCTION

Chinese calligraphy, which has a long history, has various Chinese cursive character. The Chinese cursive character (Cao Shu), which is a type of Chinese character typeface, is difficult to distinguish from the meanings [1, 2].

CNN (Convolution Neural Networks), one of the deep learning techniques, is solving the problem of image classification well. If we can use deep learning to recognize Chinese cursive character images, it could help scholars to study the Chinese cursive character of many historical books.

In this paper, we propose a recognition scheme of Chinese cursive character based on deep learning. We used our in-house dataset for training the model.

II. METHOD AND RESULTS

The ResNet-18 model was used to recognize the Chinese cursive character. The fully-connect layer of the ResNet-18 is modified to the size of the classes of our in-house dataset. We also trained the model by using our dataset which is converted into grayscale images.

A. Dataset



Figure 1: Some Examples of the Chinese Cursive Characters

As shown in Figure 1, there are various types of Chinese cursive characters. We have collected to consist and make our dataset by using off-line data from the historical books. Our dataset has 528 classes. The resolution of the original dataset images is 224x224.

B. Experiment Results

Table 1 shows the results of accuracy of recognition. In the Pre-trained, ResNet18 used the Adam as an optimizer. Original images were used and only the

last fully-connected layer was trained. In the ResNet18-SGD and the ResNet18-Adam, the resolution of the original images is changed to grayscale with a pixel resolution of 28x28. As shown in Table 1, the ResNet18-Adam with grayscale images showed the best performance in terms of accuracy when compared to the others.

Table 1: Recognition Results

Model	Channel	Accuracy
Pre-trained ResNet18	3 Channels	33.06%
ResNet18-SGD	Grayscale	74.41%
ResNet18-Adam	Grayscale	81.96%

III. CONCLUSION

In this paper, we proposed the recognition scheme of Chinese cursive character by using deep learning and showed its experiment results. Using the pre-trained ResNet18 model was not good when compared to the models trained from the beginning. Future works will be carried out in order to further improvements in terms of accuracy.

ACKNOWLEDGEMENTS

This research was supported by the MSIP(Ministry of Science, ICT & Future Planning), Korea, under the National Program for Excellence in SW(2018-0-01865) supervised by the IITP(Institute for Information & communications Technology Promotion), and supported by the Ministry of Education of the Republic of the Korea and National Research Foundation of Korea (NRF-2018S1A5B6070175)

REFERENCES

1. J. Yu, Q. Peng, "Realistic synthesis of cao shu of Chinese calligraphy", Computers and Graphics, Vol. 29, Issue. 1, pp. 145-153, 2005.
2. C. L. Liu, S. Jaeger, M. Nakagawa, "Online recognition of Chinese characters: the state-of-the-art," IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 26, No. 2, pp. 198-213, 2004.

Implementation of Image Segmentation System for Seed Image Processing

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I. INTRODUCTION

In the past, images for seed research were in the form of one seed object in an image. These images take a lot of time to create and are expensive to process. Therefore, this study proposes a technique to reduce working time and processing costs by embedding multiple seed objects in an image, and to divide the objects in the image one by one.

Recently, a South Korean research institute announced technology using super-differential sensors [3]. However, super-dividend sensors are equipment not in common university research institutes. So in this study, we're going to propose a system that processes through digital cameras.

This study applies Python Django web server to cloud computing Openstack to support efficient data generation. We want to develop a system that stores a single image with multiple seeds on the local storage in the cloud and splits it through the methods of Edge Detection and Find Contours.

II. HOW TO PROCESS THE IMAGE.

In this paper, a cloud server was built through network virtualization to configure a cloud system as an infrastructure using open-stack, storage virtualization was required for each system's storage configuration, and logically split shared resources could be allocated at the request of different users and workgroups.

Image segmentation system is a system that is mounted on cloud computing Openstack to store a single image with multiple seeds in the local repository of the cloud and process it through edge detection and contour detection to support efficient data generation.

For the generation of deep learning data, a single bean seed is placed in one image, which is costly to work and process. To solve this problem, this paper proposed a technique for storing an image containing several bean seeds on cloud local storage and then dividing the image using the methods of Edge Detection and Find Contours.

III. CONCLUSION

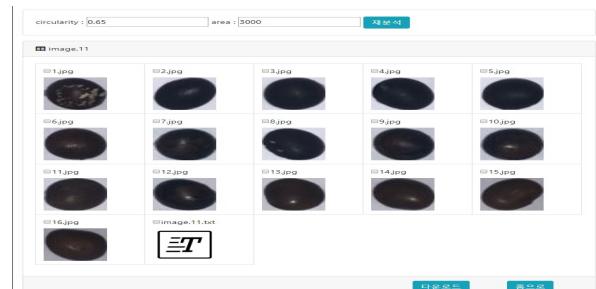


Figure 1. Images of seeds extracted

In Figure 1, the user can reanalyze the results of the image processing by modifying the Circularity and the area of the beans at the top of the web page if there are any error.

In the future, the system development research will be conducted to verify the seed information by using the image as the data of the prepared DeepLearning system.

ACKNOWLEDGEMENTS

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REFERENCES

1. Django Documentation, <https://www.djangoproject.com/>
2. Openstack Documentation, <https://docs.openstack.org/>
3. Hyoung-sub Shin, Dong-ho Lee, Kyeong-ho Shin, Jong-hwa Park, Study of Soybean Classification based on Learning Using Hyperspectral-Sensor Data, Proceedings of the Korean Society of Agricultural Engineers Conference, Vol.2018 No.- [2018], pp.267-267, 2018

Inappropriate Word Detection for Online Content Filtering based on Multi-Label Recurrent Neural Network

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I. INTRODUCTION

Accessing to online content might be harmful and dangerous to some age group especially for adolescent or kids since there might be stated suitable for their age, but still there might be some content that inappropriate for them and it failed to be detected. We extract text data from online content and then do some preprocessing stage with similarity and semantic analysis since the existing approaches to Multi-Label text categorization fall short to extract semantic information [1]. In this paper, we proposed Recurrent Neural Network (RNN) as our network model combine with Multi-Label Text Categorization (MLTC) to build a network for monitoring and filtering inappropriate online content. In addition we also try to increase the volume of our inappropriate speech dictionary so it can optimize the automatic screening of online content.

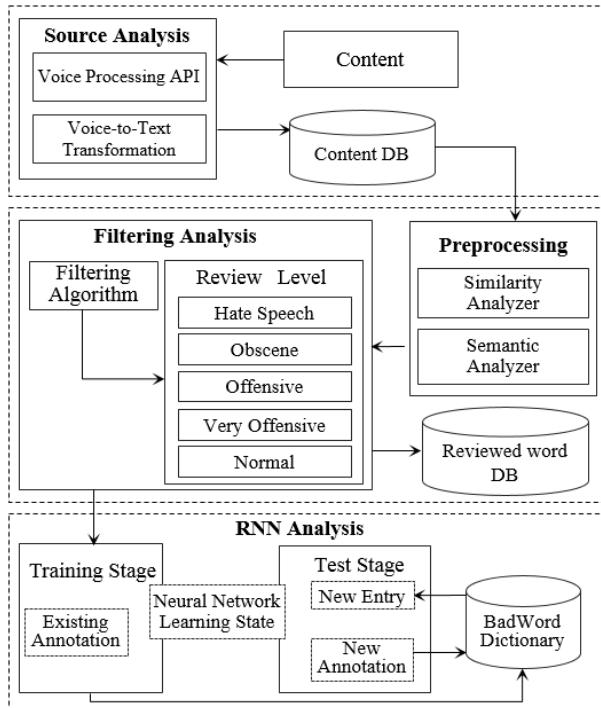


Figure 1: Conceptual architecture for inappropriate word detection

II. PROPOSED METHOD

The overall detection of the inappropriate word architecture can be seen in figure 1. The first stage of our model is to collect the online content data that

will be screened. Using provided Voice Processing API and Voice-to-text transformation tools we convert voice data to be text and then collect it into our content database. After that we perform our *Preprocessing* with similarity and semantic analysis to not only filtered the speech based on the words but also based on their sentence meaning. We proposed this stage since it can help to optimize the filtering stage. The next steps are the *Filtering Analysis*, we use this stage for two purposes which are one is to test our data and grading the inappropriately level of the content so we can proposed whether the content is appropriate for the viewer. And another purpose is to increase the volume of our inappropriate words dictionary to optimize our network learning stage and increase the accuracy of the filtering analysis process. We use Long Short-Term Memory (LSTM), Recurrent Neural Network (RNN) as our network to train and test the input data and combining our network with MLTC to process with the data labeling process.

III. CONCLUSION

This paper presents inappropriate word detection for online content monitoring using Long Short-Term Memory Recurrent Neural Network combine with MLTC. With the purpose of make filtering and grading architecture model for filtering online content based on the age prior. Based from the experiment we are able to say that LSTM, RNN perform with the high accuracy in filtering the inappropriate word and grading them prior to the group argues.

ACKNOWLEDGEMENTS

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REFERENCES

1. G. Chen, D. Ye, E. Cambria, J. Chen, and Z. Xing, “Ensemble application of convolutional and recurrent neural networks for multi-label text categorization,” in IJCNN, pp. 2377–2383, 2017.

Target-Based Semi-Supervised Machine Learning Intrusion Detection System

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SUMMARY

Feature selection of NSL-KDD data set is usually done by finding co-relationships among features, irrespective of target prediction. We aim to determine the relationship between features and target goals to facilitate different target detection goals regardless of the correlated feature selection. Particle Swarm Optimization (PSO) is utilized while projecting a weighted global with targeted classes to increase detection rate and reduce false alarms, especially for R2L and U2R, as the output target goal influences feature selections. Preliminary simulation confirms the feasibility of our proposal.

PROBLEM DEFINITION AND TASK-BASED SEMI-SUPERVISED IDS ALGORITHM

Machine learning adapts to different situations through trial and error while recognizing the pattern of surrounding area. Machine learning algorithm employed in IDS categorizes supervised and unsupervised learning, and the difference is analogous to having a class with or without a teacher.

Based on our previous work [2], the IDS can be utilized by PSO and K-means for global optimal solution and local optimal solution, respectively.

Non-attack data is more available than attack data, so most researchers have utilized only non-attack data as training model to predict whether new data is normal or an attack. For DoS and Probe data, prediction rate is good enough when only non-attack data are trained. However, prediction rate for R2L and U2R is insufficient because the amount data for R2L and U2R is not enough to discern compared to that of DoS and Probe. Therefore, the proposal utilizes both non-attack and attack data while projecting the labeled data (e.g., target detection), which would be an indicator of directionality, toward which particles in PSO will search.

The following is our algorithm procedure: feature selections by hierarchical clustering. After the feature selection, the number of clustering can be determined by silhouette clustering. Global best of particles in PSO is weighted by the targeted classes in each iteration, e.g., normal or attack, and normal, DOS, Probe, R2L, or U2R. The global minimum from PSO now becomes the centroids of K-means at the

initial stage. The cluster shape of utilizing both PSO and K-means could be changed, so we utilize “majority rules” to detect normal or attack. In the clusters, a dataset for each cluster “votes” individually and majority voter wins over the minority, so its cluster declares attack or normal. The clusters will be either normal or attack. After the training model, the detection method is employed by the nearest neighbor algorithm that we modified to determine the nearest cluster and dataset. Data's distance is determined to a closest cluster that has already been declared either normal or attack.

Notations: $W = w_{i,j} \in [0,1]$, $i = 1, \dots, n$,

$j = 1, \dots, c$, $w_{i,j}$ is each data element

The paper aims to minimize an objective function:

$$D = \arg \min \left(\sum_{i=1}^n \sum_{j=1}^c w_{i,j} \|x_i - c_j\|^2 \right)$$

where, $w_{i,j} = \min(w_{i,j}, \text{mean}(w_{target}))$

PERFORMANCE EVALUATION

In the normal vs. attack (4, 36, 3, 30, and 35), 4 is the most important feature while that for the normal vs DoS, Probe, R2L and U2L (30, 29, 31, 40, and 34) is 30. The number of clusters remains as 6 in both cases. Preliminary results show detection rate (accuracy) of 94% and 93%, respectively, for each target goal.

```
Initialize  $w^i, c_1^i, c_2^i, \pm V_{max}^i, p_a, p_g$ , direction (x,y)
1) Particles randomly
2) Update particles' locations towards the direction
3) If D is better than  $p_a$ , set  $p_a = x_a^i$ 
   and If D is better than  $p_g$ , set  $p_g = x_a^i$ 
4) Move particles within the constraints c.1-c.3
5) Evaluate D with a certain distance range,  $p(1:D)$ 
6) Update  $c_1^i$  and  $c_2^i$  accordingly and update  $w^i$ 
7) Loop to step 2 until satisfying all centroids a certain range
```

Figure 1: semi-supervised IDS algorithm using PSO

REFERENCES

1. L. Dhanabal, S.P. Shanharajah, “A study on NSL-KDD dataset for intrusion detection system based on classification algorithms,” International Journal of Advanced Research in Computer and Communication Engineering Vol. 4, Issue 6, June 2015.
2. Y.G. Kim and M.J. Lee, “Scheduling Multi-channel and Multi-timeslot in Time Constrained Wireless Sensor Networks via Simulated Annealing and Particle Swarm Optimization,” IEEE Communication Magazine, (2014), vol. 52, no. 1, pp. 122-129.

A Two-way Sign Language Interpretation Service using Deep Learning

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I. INTRODUCTION

There are many difficulties and inconveniences between the deaf and ordinary people [1]. One of them is an issue of communication. Since the public does not know sign language, they use interpreters or writing when they communicate with the deaf. And these ways take more time to communicate.

In order to solve this problem, we propose a bidirectional sign language translation service model that can convert between sign language and text/voice by using deep learning model based on YOLO (*Real-time object detection*) [2]. Figure 1 shows the service flow of the proposed system.

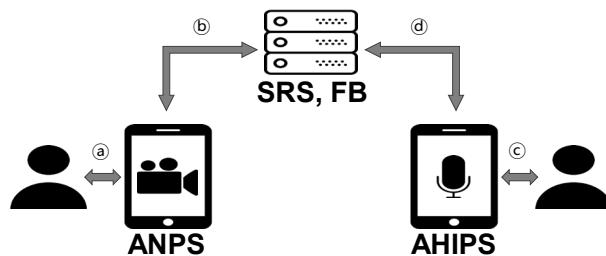


Figure 1: Service Flow of the Proposed System

II. SYSTEM ARCHITECTURE

A. Application of Normal Person's Smartphone (ANPS)

ANPS sends the sign language video which is taken by the users within the application to the *Sign Recognition Server (SRS)*. And then, it receives the results that recognized and processed from the SRS. It provides them as text on the screen of the smartphone.

B. Application of Hearing Impaired Person's Smartphone (AHIPS)

AHIPS converts the voice that is recorded by users within the application to text using the *Google Cloud STT(Speech-To-Text)* API. In addition, if the user requests to be provided the video of sign language, the converted text sends to the *FireBase(FB)*. In this case, it receives the video that is processed and transmitted from FB. And it provides the video on the screen of the phone.

C. Sign Recognition Server (SRS)

When a sign language video received from a user's smartphone is stored in the *SRS Database(DB)*, sign language is recognized in the video through a deep learning model. SRS will recognize the sign language based on YOLO. The results of the recognition are stored in the *SRS DB*. Finally, the results stored in the *SRS DB* are sent to *ANPS*.

D. FireBase (FB)

FB transmits the video which matches the text sent by *AHIPS* to *AHIPS*. The sign language video dataset is stored and managed in *FB*.

III. CONCLUSION

The hearing impaired person and the normal person will reduce the communication time between them by developing a two-way sign language interpretation application. This application will help the public to teach sign language.

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REFERENCES

1. Ko, Sang-Ki, Jae Gi Son, and Hyedong Jung. "Sign Language Recognition with Recurrent Neural Network using Human Keypoint Detection." *Proceedings of the 2018 Conference on Research in Adaptive and Convergent Systems*. ACM, pp. 326-328, 2018.
2. Nakjai, Pisit, Patcharee Maneerat, and Tatpong Katanyukul. "Thai Finger Spelling Localization and Classification under Complex Background using a YOLO-based Deep Learning." *Proceedings of the 11th International Conference on Computer Modeling and Simulation*. ACM, pp. 230-233, 2019.

A Development of Human Image Recognition Method based on Directional Histogram to Support Predictive Maintenance

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I. INTRODUCTION

Basically, smart factories monitor work environments through IoT sensor devices and cameras to support predictive maintenance. However, despite the recent support of predictive maintenance services, worker infections due to gas leakage frequently occur within the smart factory. There is also an explosion in the handling of gas and hazardous materials by non-experts placed in the workplace. This is an accident caused by a factory worker rather than a machine defect. In order to solve this problem, it is necessary to strengthen the predictive maintenance service through operator image recognition. In particular, it is necessary to support predictive maintenance by monitoring the area where the manager can't intuitively handle using the local PC.

Therefore, in this study, we propose a method to extract human from camera images through deep learning based on directional histogram in order to support predictive maintenance service. Particularly, the proposed method combines the techniques of [1], [2], and [3] to detect people within 5 seconds through real-time processing.

II. PROPOSED METHOD

In order to develop human image recognition method based on directional histogram, the main PC and 16 cameras were configured as interfaces. Instead of detecting an object using a single channel image characteristic, a method [1] of calculating various channels for a detection target region is applied. Especially, it is possible to detect even if the shape of object changes in real time by using part-based detection method [2] which can detect not only whole body but also part of body. Moreover, we combine [3] technique to detect rapidly without changing the size of the image in order to detect objects of various sizes.

In order to develop the proposed algorithm and to make the experiment, we first designed the system configuration and edited the commercial data set (COCO) and then learned it with GPU. In particular, to make sure that the program works properly on the web, 15 GB of learning data is learned through a learning machine as shown in Figure 1.

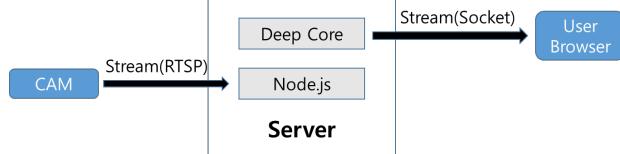


Figure 1: Structure for running on the Web

The test was carried out in real time through the IP camera, and based on the learning data, the person was found in real time on the input image. It was able to judge a person accurately with only a part of a person as well as a lot of people.

III. CONCLUSION

In this study, we proposed and developed a human image recognition method to recognize workers in a smart factory. As a result of the experiment, we detected workers within 5 seconds of detection time. After detecting the worker, the worker is recognized through the alarm function and the recording function. It is expected that the proposed and developed method will be useful for the intelligent predictive maintenance monitoring service in smart factory.

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REFERENCES

1. P. Dollar, Z. Tu, P. Persona, and S. Beloglie, "Integral channel features," in Proceedings of the British Machine Vision Conference. BMVC Press, London, pp. 91. 1-11, 2009.
2. P. F. Felzenszwalb, R. B. Girshick, D. McAllester, and D. Ramanan, "Object Detection with Discriminatively Trained Part-Based Models", IEEE Transactions on Pattern Recognition, Vol. 32, No. 9, pp. 1627–1645, 2010.
3. R. Benenson, M. Mathias, R. Timofte, and L. V. Gool, "Pedestrian detection at 100 frames per second", IEEE Conference on Computer Vision and Pattern Recognition. CVPR 2012, pp. 2903-2910, 2012

A Design and Implementation on The Review Regulation of Online Content

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I. INTRODUCTION

One-Person Media concept its generally about the action of displaying an individual's own posting, picture or films to the public. As the 'one-person media' market has grown dramatically is also facing some issues related to the online content review regulation. As the popularity of 'one-person media' has been growing, overheated competition has prompted many hosts to do strange and bizarre things that are not suited to be seen by a group of ages. Nowadays, many company of online content provider have already developed an API to do deal with this issue, including YouTube that currently provided with the best API [1]. YouTube introduced an AI called YouTube Bot to compensate for this, but the lack of an ad-friendly policy and a clear guideline among its operating policies has led to major and minor controversies. The controversial issue is the Elsa Gate. "Elsa Gate" refers to an incident in which video clips were uploaded featuring suggestive scenes and unethical content, disguised as an animation or live footage featuring characters favored by infants or children. Based on this issue, we proposed some design of review regulation and implement it to do the content grading classification.

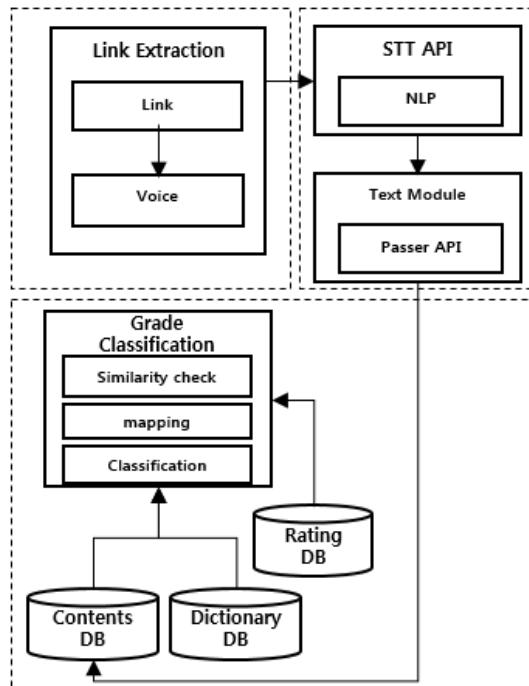


Figure 1: Design Architecture of Review Regulation

II. PROPOSED DESIGN

Our proposed Review Regulation design described on figure 1. As the stage to collect the data, user input the link and then the system crawls to the directed address and convert the video file into 1-channel Free Lossless Audio Codec (FLAC) format. Using the Google Speech-to-Text(STT) Api then we convert the audio data into the text. And then the converted text file uses the parsing API to select meaningful word. After that we save the text content data into our Contents Database. The next stage is we do the *Grade Classification* of the content. This stage devided into 3 stage of classification and analyzing. First we do some *similarity analysis* between the content in Content Database and the Dictionary Database. Then it examines and update the mapping of words related to Bad word and then the system classifies the bad word against the criteria of the Rating Database.

III. CONCLUSION

In this paper, we design and implement a one - t person media classifier through voice analysis. The designed classifier analyzes the image requested by the user and calculates the rating of the corresponding image. Accordingly, the user can know the information of the corresponding image even if the user does not view the corresponding image, so that the user can select and receive the desired information.

ACKNOWLEDGEMENTS

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REFERENCES

1. Kępuska, V.Comparing Speech Recognition Systems (Microsoft API, Google API And CMU Sphinx). International Journal of Engineering Research and Applications,(2017) 07(03), 20–24.

Data Analytics in Sport: An Investigation of Factors Contributing to Winning NBA Championships

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I. INTRODUCTION

The explosion of data has affected virtually every aspect of our lives, bringing relevance to the realm of data analytics (Berry & Linoff, 2004). Data analytics enables people to gain better knowledge and deeper understandings of many social occasions (Berry & Linoff, 2004). The sport industry is no exception. Data analytics has become an essential part of every team's decision-making process, used to gain a competitive edge in their sports (Fried & Mumcu, 2017).

During the 2017-2018 season, 30 NBA teams played a total of 1230 games and attracted more than 22 million fans to arenas, setting a new record. In addition, the number of people watching NBA broadcasts on television has reached its highest since 2008. With such attention being paid to the sport, a large amount of game data were recorded at every single game. However, with such abundant game information, fans are left to contemplate one question: *What does my team need to do well to improve its chances of winning a championship?*

The purpose of the current study is to identify key factors that contribute to winning NBA championships through data analytics.

II. METHODS

A binary logistic regression analysis was used to identify key factors that influence NBA championship outcomes. The researchers analyzed 114 NBA championship games played between 2009 and 2018 seasons. The outcomes (the dependent variable) of the games were coded as a "1" for a win and a "0" for a loss. Ten factors pertaining to the game (locations, field goal percentage, 3-point percentage, free-throw percentage, rebounds, assists, steals, shot blocks, turnovers, and personal fouls) were used as predictor variables. Game statistics were retrieved from NBA websites.

III. RESULTS

The logistic regression model was statistically significant, $\chi^2(10) = 82.085$, $p < .005$. The model explained 68.4% (Nagelkerke R^2) of the variance in

game outcomes.

Table 1. Logistic Regression on NBA Championship outcomes

	B	S.E.	Wald	df	Sig.
Locations	-1.460	.664	4.830	1	.028
FG	32.286	7.622	17.945	1	.000
3PTs	10.495	4.107	6.529	1	.011
FT	6.928	3.516	3.882	1	.055
RB	.290	.074	15.547	1	.000
Assists	-.085	.079	1.151	1	.283
steals	.284	.117	5.867	1	.015
blocks	.201	.132	2.324	1	.127
Turnovers	-.415	.118	12.487	1	.000
Fouls	.026	.072	.127	1	.721
Constant	32.744	7.349	19.850	1	.000

As presented in Table 1, the logistic regression showed that six factors (location, field goal, 3-pts shots, rebounds, steals, and turnovers) significantly influenced the game outcomes. More specifically, the location and turnovers negatively influence the outcomes, which means that home teams (coded as a "1") have a higher chance of winning games than away teams (coded as a "2"), and teams that committed fewer turnovers have a higher chance of winning games.

IV. CONCLUSION

This study used data analytics to provide valuable insights for teams, coaches, and players to increase chances of winning NBA championships. These individuals should focus on improving field goal and 3-pts shooting percentage, rebounds, and steals, and reducing turnover to win NBA championships.

REFERENCES

1. Berry, M. & Linoff, G. "Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management". Wiley Computer Publishing, 2nd Ed, 2004.
2. Fried, G., & Mumcu, C. "Sport Analytics: A Data-Driven Approach to Sport, Business, and Management". New York: Routledge, 2017.

Characterization of CYP106A6 activity and active residue prediction by Deep Learning

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I. INTRODUCTION

Cytochrome P450 (CYP) is an enzyme that is found in all life forms in the worldwide and is combined with heme. CYP has been extensively studied as a biocatalyst in various fields. Bacterial-derived CYPs require an electron transport system and nicotinamide adenine dinucleotide (NAD(P)H) to have activity., which function by transferring electrons to the enzyme. Its main function is hydroxylation with endogenous and xenobiotic chemicals including steroids. Steroids play an important role in humans, such as hormones and metabolism. Steroid hydroxylase is rarely found in bacterial, one of which is the CYP106A subfamily. We isolated a new CYP106A6 from *Bacillus* sp. The enzyme has approximately 78% sequence identity with CYP106A1 from *Bacillus megaterium* was confirmed. Three types of steroids were used as substrates to demonstrate the function of CYP.

The most well-known CYP106A2 was isolated from *Bacillus megaterium* and *Bacillus* sp ATCC 13368, and catalyzes hydroxylation at carbon number 15 of the steroid [1]. These proteins have been determined their protein structure and registered with the PDB. In particular, both the non-binding form and the binding form have been identified and are useful for active residue studying. Residues involved in substrate binding are related to active pockets. Programs to interpret and predict substrate-protein interactions have been actively studied. Recently, a program using multi-layer CNN has been studied [2]. In this study, we want to study the residues of active pockets through substrate-protein interactions based on deep learning.

II. PROPOSED METHOD

The CYP106A6 gene is 1,233 bp in length encoding a 410-amino acid protein. It was isolated from *Bacillus* sp. The gene was amplified by PCR and ligated with pET 28 vector. *E. coli* C41 was used as a host cell. The CYP106A6 protein was over-expressed and purified for activity confirmation. 4-androstanedione, progesterone, and testosterone were used as substrates to identify the function of CYP using HPLC and LC-MS analysis. Prediction of active sites and residues uses a deep learning method.

III. CONCLUSION

These results provide data on the exploration and structural interpretation of enzymatic activity, which I believe will be useful in future biotechnological engineering. Also, a reliable characterization of active binding sites in proteins may support studies focused on their binding modes and active analysis.

ACKNOWLEDGEMENTS

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REFERENCES

1. Kim KH, Lee CW, Dangi B, Park SH, Park H, Oh TJ, Lee JH, Crystal structure and functional characterization of a cytochrome P450 (BaCYP106A2) from *Bacillus* sp. PAMC 23377, *J. Microbiol. Biotechnol.*, 2017
2. Limeng Pu, Rajiv Gandhi Govindaraj, Jeffrey Mitchell Lemoine, Hsiao-Chun Wu and Michal Brylinski "DeepDrug3D: Classification of ligand-binding pockets in proteins with a convolutional neural network", *PLoS Comput Biol* 15(2): e1006718. <https://doi.org/10.1371/journal.pcbi.1006718>, 2019

Characterization of CYP106A2 activity and active residue prediction by Deep Learning

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I. INTRODUCTION

Cytochrome P450 (CYP) is an enzyme that is found in all life forms in the worldwide and is combined with heme. Bacterial-derived CYPs require an electron transport system and nicotinamide adenine dinucleotide (NAD(P)H) to have activity. Its main function is hydroxylation with endogenous and xenobiotic chemicals including steroids. Steroids play an important role in humans, such as hormones and metabolism. Steroid hydroxylase is rarely found in bacterial, one of which is the CYP106A subfamily. The most well-known CYP106A2 was isolated from *B. megaterium* and *B.* sp. ATCC 13368. These catalyze hydroxylation at carbon number 15 of the steroid [1]. In addition, their protein structures in the non-binding form and the binding form have been determined for active residue studying.

Deep learning build a special type of algorithms from data set in machine learning. It has continued to develop excellent performance in computer vision, natural language processing, and other fields of research. Convolutional Neural Networks (CNN), which filters to find the features of the image, and Recurrent Neural Networks (RNN), which contains a hidden layer, belongs to the deep learning algorithm. These popular methods are used for various classification and characterization. Residues involved in substrate binding are related to active sites. Many structure-based approaches to classify ligand-protein binding sites build on pocket similarity detection. Based on deep learning algorithms, many research has been introduced to predict affinity between substrate and protein, and to search for active residues. Recently, a DeepDrug3D program for classifying binding pockets using multi-layer CNN has been studied [2].

In this study, we aim to predict active residues through ligand-protein information on steroid hydroxylase based on deep learning.

II. PROPOSED METHOD

The CYP106A2 gene is 1,236 bp in length encoding a 411-aa protein. It was isolated from *B.* sp. The gene was amplified by PCR and ligated with pET28 vector. The CYP106A2 protein was over-expressed and purified for activity confirmation. 4-androstenedione and nandrolone were used as substrates to identify the function of CYP using HPLC and LC-MS analysis [1]. Deep learning is used to predict active sites and residues in steroid hydroxylase datasets.

III. CONCLUSION

These results provide data on the exploration and structural interpretation of enzymatic activity, which I believe will be useful in future biotechnological engineering. Also, a reliable characterization of active binding sites in proteins may support studies focused on their binding modes and active analysis.

ACKNOWLEDGEMENTS

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REFERENCES

1. Kim K.H., Lee C.W., Dangi B., Park S.H., Park H., Oh T.J., and Lee J.H., "Crystal Structure and Functional Characterization of a Cytochrome P450 (BaCYP106A2) from *Bacillus* sp. PAMC 23377", *J. Microbiology and Biotechnology*, 27(8), 1472-1482, 2017.
2. Limeng Pu, Rajiv Gandhi Govindaraj, Jeffrey Mitchell Lemoine, Hsiao-Chun Wu and Michal Brylinski, "DeepDrug3D: Classification of ligand-binding pockets in proteins with a convolutional neural network", *PLoS Computational Biology*, 15(2), 1-23, 2019.

Leveraging Large-scale Simulation for Smart Sustainable Transportation: Ride-share scenarios in New York City

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I. INTRODUCTION

Despite the prevalent use of simulation methods in the majority of engineering and science, the strategic decision making process in ride-sharing and urban mobility deployment has not heavily relied on simulation models, not only because they do not necessarily require simulation techniques, but also because there are no proper simulation packages to analyze “what-if” scenarios.

This abstract presents a new type of simulation framework targeting large-scale dynamic ride-share systems and demonstrate the effectiveness of dynamic ride-share.

II. DATA AND METHODOLOGY

A. Simulation Framework

The simulation framework[1] is built based on a time-driven scheme, similar to microscopic traffic simulations where each simulation object's movement and operation is observed continuously over time. It loads a transportation network for vehicle routing, creates vehicle objects over the road network, and imports trip request including passenger pickup time windows, number of travelers, and origin-destination locations. For each time step, the simulation generates new pickup requests based on the imported trip files. The fleet optimization module finds the best vehicles to assign the new pickup requests in real-time. All vehicles get updated with the new schedules and change their routes and itineraries accordingly. At the same time vehicles' positions are updated based on the current routes and link travel speeds. Figure 1 provides a snapshot of simulation.

B. Dataset

For the transportation network, the study uses the LION geographic base file of New York City streets at Department of City Planning, New York City, containing 16,782 nodes and 23,337 links. For dynamic pickup requests, Yellow taxi trip records from TLC[2] is used. Each trip record provides pickup-dropoff locations, trips distance, timestamps,

and passenger count. Taxi dataset from a typical Wednesday in 2016 is used as a base trip demand, in which a total of 407,305 trips (662,455 travelers). The average trip distance is about 4 miles and 84% of trips are in Manhattan borough.

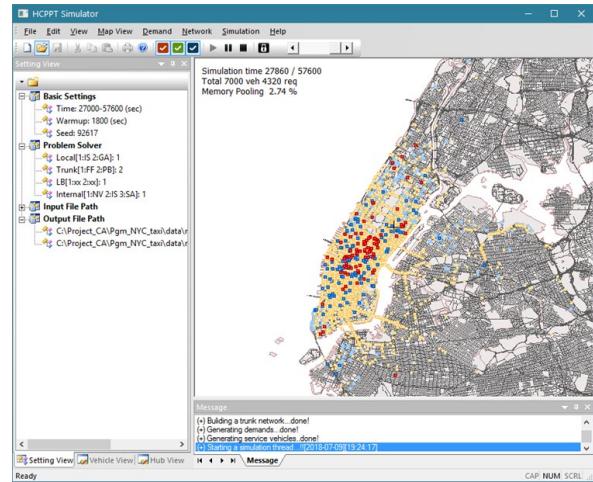


Figure 1: Snapshot of simulation

C. Scenarios

This simulation study considers daytime Manhattan trips from 8am to 4pm. The baseline scenario assumes 7,000 taxi service without ride-share. For dynamic ride-share scenario, we assume various fixed fleet sizes (7,000 to 3,000) to serve real-time ride request by optimization the operating efficiency where the problem is open-ended and the vehicle schedules need to be optimize periodically. The dispatch algorithm[3] tries to minimize incremental cost of dispatch, containing maximum detour and wait time constraints as passenger quality of service (QoS). Each vehicle has 6 seats and allows ride-share.

III. RESULTS

The impact of ride-share is investigated by comparing the base and ride-share scenarios. Compared to the base scenarios, the ride-share shows higher passenger completion rate with 7,000 to 5,000 vehicles as shown in Figure 2. At the same

time, the ride-share demonstrates lower vehicle miles traveled (VMT) and vehicle deadhead miles in Figure 3, which is an important indicator to measure the effectiveness in sustainability.

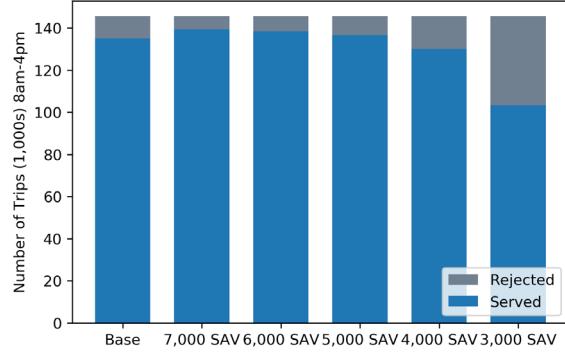


Figure 2: Trip completion comparison

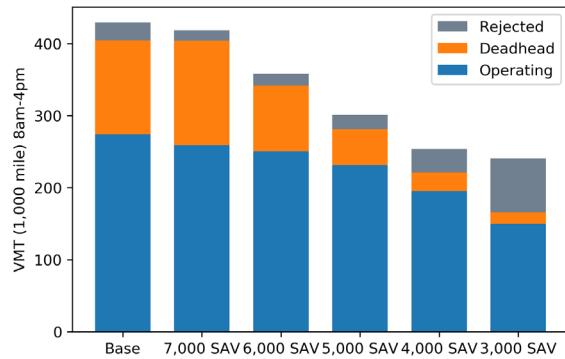


Figure 3: VMT comparison

Figure 4 and 5 show the vehicle utilization status and passenger travel time distribution respectively. Given the demand pattern, it is conceivable that as the fleet size reduces, the utilization increases by promoting passenger pooling. On the other hand, the increased ride-share chances may slightly deteriorate the passenger travel time as shown in Figure 5.

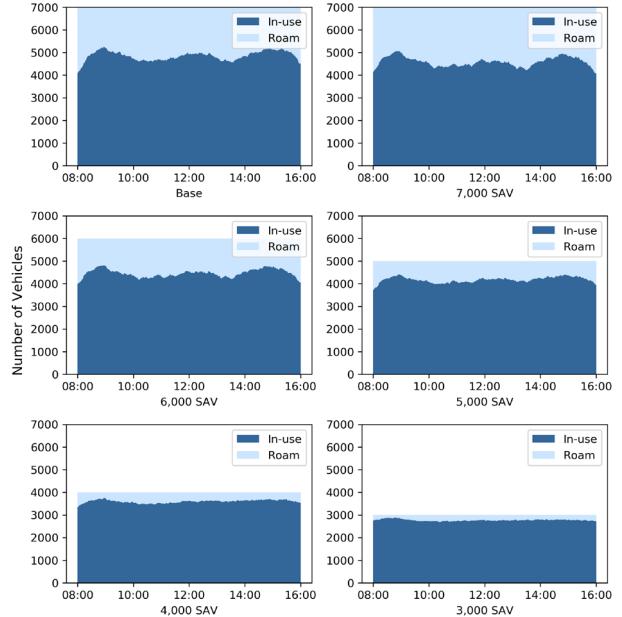


Figure 4: Vehicle utilization status over time

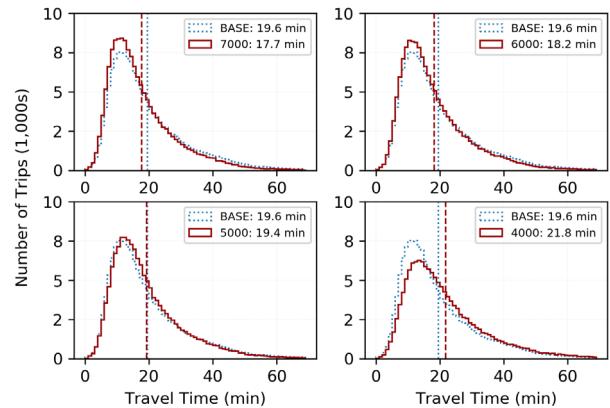


Figure 5: Passenger travel time distribution

REFERENCES

1. Jung, J., and Jayakrishnan, R., "Simulation framework for modeling large-scale flexible transit systems." *Transportation Research Record* 2466, 31-41, 2014.
2. TLC (2018b). "TLC Trip Record Data." [NYC.gov](https://www1.nyc.gov/site/tlc/about/tlc-trip-record-data.page), accessed Apr. 2019.
3. Jung, J., Jayakrishnan, R., and Park, J. Y., "Dynamic shared-taxi dispatch algorithm with hybrid-simulated annealing." *Computer-Aided Civil and Infrastructure Engineering*, 31(4), 275-291, 2016.

Data Analytics for Process Improvements of Wire + Arc Additive Manufacturing

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SUMMARY

Additive manufacturing (AM) is considered by many to be the next "Disruptive Technology" and has the potential to change the manufacturing landscape due to its current technical advancements [1]. However, it has still several barriers for the general adoption in industries. They can be categorized into seven issues: (1) standards and guidelines, (2) modeling and simulation tools, (3) AM designing tools, (4) data information management, (5) limited number of available material, (6) building capacity and time, and (7) certification and qualification.

The wire + arc additive manufacturing (WAAM) process is well-fitted to medium- and large-sized parts (e.g., aircraft engines and airframe structures) [2]. This process uses a metal wire as feedstock and an arc as the heat source, instead of the powder and laser/electron beam in the typical powder-based additive manufacturing (AM) processes. It has several advantages: (1) high deposition rates (near 10 kg/hour), (2) inexpensive and wide selections of wire materials, (3) affordable system setup cost, and (4) high energy efficiency ($\approx 90\%$).

AM can be considered a SM system that reflects an ideal opportunity to apply ICT throughout management of its product life cycle. Current metal AM processes are becoming increasingly complicated by the addition of ICTs such as inexpensive smart sensors and wireless networks in an effort to increase efficiency of AM systems. Despite this addition, many current practices remain based on hand-tuned parameters that rely on the knowledge and experience of manufacturers. With this current implementation of advanced manufacturing processes and ICTs in SM, human decision makers are still faced with difficulties in managing the AM processes.

In this context, data analytics will be investigated as one of the possible innovative solutions to fill these

industrial needs. In particular, predictive modeling and analysis methodologies provide the possibility to address tasks and problems for satisfying different manufacturing requirements and constraints. Despite this potential, there are several specific and critical hurdles that prevent the widespread use of modeling and analysis methodologies including (1) the model's high uncertainty and complexity; (2) the model's inability to deal with the multiple, conflicting objectives; and (3) the dynamic nature of manufacturing systems. Accordingly, a solution is needed, which can assist in decision-making, adapting to new situations, and predicting and correcting fabrication problems in dynamic manufacturing situations such as AM. Figure 1 shows the machine learning models for defects analysis in WAAM.

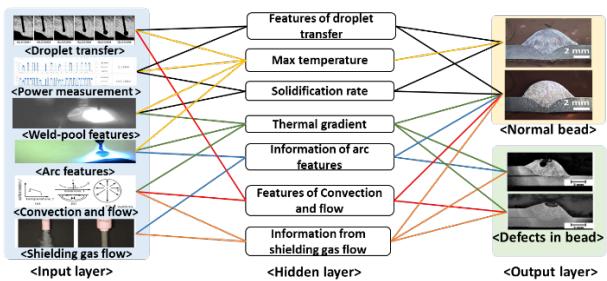


Figure 1. Machine learning model for defects analysis in WAAM.

Keywords: additive manufacturing, data analytics

REFERENCES

1. T.D. Ngo, A. Kashani, G. Imbalzano, K.T.Q. Nguyen, D. Hui, Additive manufacturing (3D printing): A review of materials, methods, applications and challenges, Composites Part B: Engineering. 143 (2018) 172–196.
2. S.W. Williams, F. Martina, A.C. Addison, J. Ding, G. Pardal, P. Colegrave, Wire + arc additive manufacturing, Materials Science and Technology. 32 (2016) 641–647.

A Framework to Support Data Interoperability Provisioning for Web Objects based Healthcare Analytic Applications

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SUMMARY

The Paper proposes a novel framework to support data interoperability for healthcare analytic applications. This framework is evaluated in Web Objects enabled environment.

Keywords: Data Interoperability, Healthcare Data Analytics, VO, Web Objects.

I. Introduction

The data interoperability provisioning framework supported by the Web Objects enabled IoT environment, enhances data sharing, integration and analytics capability and provides diverse service features and resources for connected smart healthcare environments. The Web Objects provide a functional structure of the Internet of Things (IoT) in the World Wide Web environment [1]. The data interoperability framework incorporates data mediation capabilities together with the Web Objects capabilities to provide enhanced interoperability configurations as shown in figure 1.

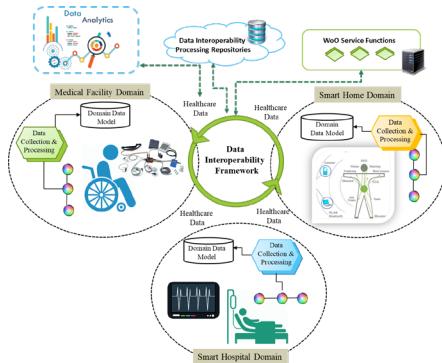


Figure 1. Data interoperability provisioning in heterogeneous healthcare domains

II. Data Interoperability Provisioning Model in Healthcare Domains

Smart healthcare environments are growing with a large number of heterogeneous objects producing diverse types of data. Due to the lack of adequate interoperability provisioning, data sharing and integration in these domains has become a challenging task. Proposed data interoperability framework provides Web Objects enabled settings in which healthcare devices are digitized using Virtual Objects (VOs) [2] providing updates on real-world objects. The interoperability framework provides mediation services to harmonize heterogeneous data from different domains using common data models and linked vocabularies.

III. Multi-Layered Framework of Data Interoperability Provisioning in Healthcare

Data interoperability framework provides a multi-layered architecture for data sharing and exchange and integrated analytic service features. The healthcare application users are empowered to create, control and orchestrate services with service management functions as illustrated in figure 2. The analytics processing functions provide learning and reasoning based feature on healthcare data. The object processing functions facilitate the creation, control, and management of virtualized objects. The data interoperability processing functions provide a suite of microservices for data annotation, alignment, translation, query processing, and synchronization. Common data model and metadata descriptions are provided to align heterogeneous data models using a central object repository. Semantic ontologies provide semantic level mediation among domain concepts.

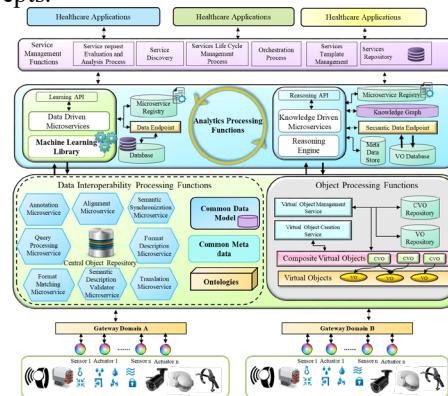


Figure 2. A framework to support interoperability for healthcare analytics applications

Acknowledgment

This research was supported by the MSIT(Ministry of Science and ICT), Korea, under the ITRC(Information Technology Research Center) support program(IITP-2018-0-01396) supervised by the IITP(Institute for Information & Communication Technology Planning and Evaluation).

References

- [1] "Y.4452 : Functional framework of web of objects." [Online]. Available: <http://www.itu.int/rec/T-REC-Y.4452>.
- [2] S. Ali, M. A. Jarwar, I. Chong, S. Ali, M. A. Jarwar, and I. Chong, "Design Methodology of Microservices to Support Predictive Analytics for IoT Applications," Sensors, vol. 18, no. 12, p. 4226, Dec. 2018.

Usability Testing of Heptic Feedback Handles of Intelligent Mobility Cane

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I. INTRODUCTION

Various Smart Cane designs include sensors to detect obstacles and inform the user using audio and/or haptic methods. Some designs use a haptic interface on the cane handle to inform the user.

This study sought to address this problem statement by collaborating with eleven blind participants to evaluate a prototype cane our smart cane prototype called a prototype cane called an Intelligent Mobility Cane (IMC). This cane uses a vibration interface on the handle to inform the user of an upcoming obstacle. 10 of 11 participants indicated they need more time with the IMC to indicate with certainty they would substitute their regular cane with the IMC.

II. Intelligent Mobility Cane

This study involved designing a prototype called Intelligent Mobility Cane (IMC). It consists of a white foldable walking cane mounted with an ultrasonic sensor towards the bottom of the cane and two vibrators on the handle. Each participant walked with the IMC along a prescribed path. He/she provided feedback on the handle design and vibration notification method. A semi-structured interview was conducted with each participant after evaluating the IMC, focusing on the handle design and notification method.

A. Design

The cane was mounted with Maxbotix MB1240 ultrasonic sensor, Arduino Uno microcontroller, two vibrator motors, and male to male jumper wires. The Maxbotix MB1240 ultrasonic sensors were selected for their low power consumption and low sensor noise interference capabilities.

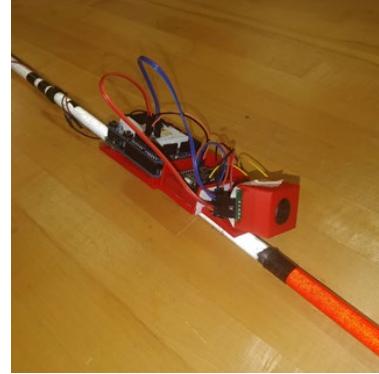


Figure 1: Intelligent Mobility Cane

III. Evaluation

A. Participants

Eleven blind participants were involved in the study. The project team requested the Association for the Blind and Visually Impaired (ABVI) in Rochester, NY to recruit participants. The recruitment criteria was that each participant has to 1) be at least 18 years of age, 2) speak English, and 3) use a cane for their daily navigation needs.

B. Evaluations

To help compare the Smart Cane and the regular cane, interview questions were categorized into two areas: vibrators on the cane handle and the vibrations themselves.

III. Conclusion

The result indicates that the heptic feedbacks does help blinds and visual impaired to navigate more easily and effective. However, participants shared several opportunities for enhancements and new features.

REFERENCES

1. Kim S., Cho K. Usability and Design Guidelines of Smart Canes for Users with Visual Impairments; International Journal of Design, 7(1), 99-110, 2013.

Data Analytics in Sport: An Investigation of Factors Contributing to Winning NBA Championships

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I. INTRODUCTION

The explosion of data has affected virtually every aspect of our lives, bringing relevance to the realm of data analytics (Berry & Linoff, 2004). Data analytics enables people to gain better knowledge and deeper understandings of many social occasions (Berry & Linoff, 2004). The sport industry is no exception. Data analytics has become an essential part of every team's decision-making process, used to gain a competitive edge in their sports (Fried & Mumcu, 2017).

During the 2017-2018 season, 30 NBA teams played a total of 1230 games and attracted more than 22 million fans to arenas, setting a new record. In addition, the number of people watching NBA broadcasts on television has reached its highest since 2008. With such attention being paid to the sport, a large amount of game data were recorded at every single game. However, with such abundant game information, fans are left to contemplate one question: *What does my team need to do well to improve its chances of winning a championship?*

The purpose of the current study is to identify key factors that contribute to winning NBA championships through data analytics.

II. METHODS

A binary logistic regression analysis was used to identify key factors that influence NBA championship outcomes. The researchers analyzed 114 NBA championship games played between 2009 and 2018 seasons. The outcomes (the dependent variable) of the games were coded as a "1" for a win and a "0" for a loss. Ten factors pertaining to the game (locations, field goal percentage, 3-point percentage, free-throw percentage, rebounds, assists, steals, shot blocks, turnovers, and personal fouls) were used as predictor variables. Game statistics were retrieved from NBA websites.

III. RESULTS

The logistic regression model was statistically significant, $\chi^2(10) = 82.085$, $p < .005$. The model explained 68.4% (Nagelkerke R^2) of the variance in

game outcomes.

Table 1. Logistic Regression on NBA Championship outcomes

	B	S.E.	Wald	df	Sig.
Locations	-1.460	.664	4.830	1	.028
FG	32.286	7.622	17.945	1	.000
3PTs	10.495	4.107	6.529	1	.011
FT	6.928	3.516	3.882	1	.055
RB	.290	.074	15.547	1	.000
Assists	-.085	.079	1.151	1	.283
steals	.284	.117	5.867	1	.015
blocks	.201	.132	2.324	1	.127
Turnovers	-.415	.118	12.487	1	.000
Fouls	.026	.072	.127	1	.721
Constant	32.744	7.349	19.850	1	.000

As presented in Table 1, the logistic regression showed that six factors (location, field goal, 3-pts shots, rebounds, steals, and turnovers) significantly influenced the game outcomes. More specifically, the location and turnovers negatively influence the outcomes, which means that home teams (coded as a "1") have a higher chance of winning games than away teams (coded as a "2"), and teams that committed fewer turnovers have a higher chance of winning games.

IV. CONCLUSION

This study used data analytics to provide valuable insights for teams, coaches, and players to increase chances of winning NBA championships. These individuals should focus on improving field goal and 3-pts shooting percentage, rebounds, and steals, and reducing turnover to win NBA championships.

REFERENCES

1. Berry, M. & Linoff, G. "Data Mining Techniques: For Marketing, Sales, and Customer Relationship Management". Wiley Computer Publishing, 2nd Ed, 2004.
2. Fried, G., & Mumcu, C. "Sport Analytics: A Data-Driven Approach to Sport, Business, and Management". New York: Routledge, 2017.

Implementation of Image Segmentation System for Seed Image Processing

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I. INTRODUCTION

In the past, images for seed research were in the form of one seed object in an image. These images take a lot of time to create and are expensive to process. Therefore, this study proposes a technique to reduce working time and processing costs by embedding multiple seed objects in an image, and to divide the objects in the image one by one.

Recently, a South Korean research institute announced technology using super-differential sensors [3]. However, super-dividend sensors are equipment not in common university research institutes. So in this study, we're going to propose a system that processes through digital cameras.

This study applies Python Django web server to cloud computing Openstack to support efficient data generation. We want to develop a system that stores a single image with multiple seeds on the local storage in the cloud and splits it through the methods of Edge Detection and Find Contours.

II. HOW TO PROCESS THE IMAGE.

In this paper, a cloud server was built through network virtualization to configure a cloud system as an infrastructure using open-stack, storage virtualization was required for each system's storage configuration, and logically split shared resources could be allocated at the request of different users and workgroups.

Image segmentation system is a system that is mounted on cloud computing Openstack to store a single image with multiple seeds in the local repository of the cloud and process it through edge detection and contour detection to support efficient data generation.

For the generation of deep learning data, a single bean seed is placed in one image, which is costly to work and process. To solve this problem, this paper proposed a technique for storing an image containing several bean seeds on cloud local storage and then dividing the image using the methods of Edge Detection and Find Contours.

III. CONCLUSION

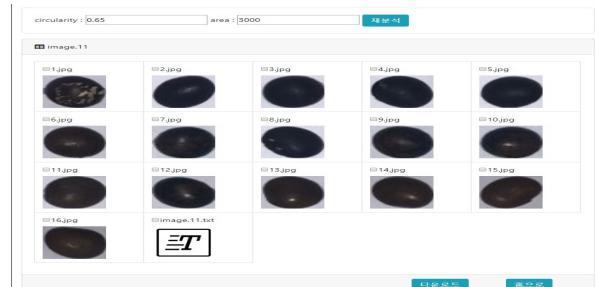


Figure 1. Images of seeds extracted

In Figure 1, the user can reanalyze the results of the image processing by modifying the Circularity and the area of the beans at the top of the web page if there are any error.

In the future, the system development research will be conducted to verify the seed information by using the image as the data of the prepared DeepLearning system.

ACKNOWLEDGEMENTS

This work was carried out with the support of "Cooperative Research Program for Agriculture Science and Technology Development (Project No. PJ014512022019)" Rural Development Administration, Republic of Korea

REFERENCES

1. Django Documentation, <https://www.djangoproject.com/>
2. Openstack Documentation, <https://docs.openstack.org/>
3. Hyoung-sub Shin, Dong-ho Lee, Kyeong-ho Shin, Jong-hwa Park, Study of Soybean Classification based on Learning Using Hyperspectral-Sensor Data, Proceedings of the Korean Society of Agricultural Engineers Conference, Vol.2018 No.- [2018], pp.267-267, 2018

Privacy and Security Access Control in the IoT Connected Internet

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I. INTRODUCTION

This abstract discuss privacy and security control issues in the IoT Connected Internet.

As many IoT devices are connected to the Internet exponentially, we should be able to control privacy and security properly for seamless and safe usage of the Internet.

II. PRIVACY AND SECURITY CONTROL IN IoT

A. A New Paradigm in the Internet

As the number of IoTs connected to the Internet is growing so fast, it became necessary to do a proper access control for a safer Internet computing and communications environment establishment.

B. Security Control Issue in IoT

The state of the art of security control issue in IoT will be discussed.

C. Privacy Control Issue in IoT

The state of the art of privacy control issue in IoT will be discussed.

D. Recent Developments in IoT Security and Privacy

Recent development trends in IoT security and privacy will be explored.

III. SOME NOTABLE CONSIDERATIONS

Some notable considerations in the IoT security and privacy control considering the current IoT connected Internet will be discussed.

A. User – IoT Client – IoT Server Architecture

Privacy and security control issues in *User – IoT Client – IoT Server Architecture* will be discussed.

B. Security and Privacy Control in User – IoT Client Paradigm

Privacy and security control issues in *User – IoT Client Paradigm* will be discussed.

C. Security and Privacy Control in IoT Client – IoT Server Paradigm

Privacy and security control issues in *IoT Client – IoT Server Paradigm* will be discussed.

D. Security and Privacy Control in IoT Server – IoT Server Paradigm

Privacy and security control issues in *IoT Server – IoT Server Paradigm* will be explored.

III. FUTURE RESEARCH DIRECTIONS

Future research directions in Privacy and Security Access Control in the IoT Connected Internet will suggested.

REFERENCES

1. Young B. Choi, Service Order Handling, Interdisciplinary Ph.D. Dissertation, The University of Missouri-Kansas City, USA, December 1995.
2. NIST, “NIST Privacy Framework: An Enterprise Risk Management Tool,” *Discussion Draft*, US Department of Commerce, April 30, 2019.
3. NIST, Draft NISTIR 8228: Considerations for Managing IoT Cybersecurity and Privacy Risks Out for Public Comment, September 26, 2018.
4. NIST Cybersecurity for IoT Program, <https://csrc.nist.gov/CSRC/media/Presentations/NIST-Cybersecurity-for-IoT-Program/images-media/NIST%20Cybersecurity%20for%20IoT%20Program.pdf>
5. World Ordering Information Agreement (Formerly SP to SP Ordering) – TMF 603, Version 1.0, May 1999. (Official publication of TMF, Co-authors: TeleManagement Forum (TMF) World Ordering Team)

Community Participatory Mapping Crowdsourced Platform for Monitoring Air Pollution

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ABSTRACT

BACKGROUND

In previous years, South Korea struggled with severe air pollution at high levels. What sources exactly contribute to the high level of particulate matters (PM), which can be detrimental to our health is largely undetermined. The causes of PM air pollution are very complicated as there are external and internal factors. Investigating into these causes is still ongoing; however, the major culprits are automobile traffic, and energy & industrial activity from China. There is no clear understanding of which sources exactly contribute to PM2.5 in South Korea.

METHODS

As part of our public health exposome data at Meharry Medical College in US, 3km by 3km grid level of daily measurement of PM2.5 data in the southeast region of the United States was created from 2003 to 2011. Satellite measures were derived from regression models of aerosol optical depth collected by the Moderate Resolution Imaging Spectro-radiometer instrument onboard the National Aeronautics and Space Administration Aqua satellite.

In South Korea, there were not enough monitoring locations to provide PM data to a specific location. Most recorded and analyzed data are from a limited number of monitoring stations and do not reflect data from where most people reside. Recent debates center around conflicting characterizations of air pollution that result from the relying on government air pollution measurements versus citizen reported air pollution measurements.

RESULTS

The Community Mapping Center in S. Korea has developed DIY(Do It Yourself) PM monitoring kits (indoor and outdoor), and is currently working on developing the Particulate Matter Citizen Information Network (PMCIN) to educate the public and better understand what contributes to the levels

of fine dust in the air. PMCIN is an open data platform that connects community collected air pollution data with existing air pollution monitoring data, and leverages existing infrastructure and research. The portal is accessible to the public and the interactive map has relevant GIS layers such as wind, air pressure, and traffic and industry point data. The Community Mapping Center engages the public from the outset, involving them in the collection and use of PM data to encourage grassroots public health campaigns for air pollution mitigation in South Korea. The cases of community mapping projects produced detailed spatial levels of PM air pollution will be presented.

ACKNOWLEDGEMENTS

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Design of Computer Education Worksheets in Elementary Schools

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I. INTRODUCTION

The contents of programming education for elementary school in the 2015 revisions to the national curriculum are not sufficient in South Korea. Therefore I developed worksheets in Scratch Programming Education for elementary school students. Once students have completed a level, they can be promoted to higher level by using these, regardless of their grade or age.

II. HOW TO DESIGN WORKSHEETS

The Scratch programming language makes it possible to do programming in the form of organizing puzzle-shaped instruction words called blocks. This is consequently easier to learn and allows learners to make less syntax errors compare to using other programming language.

Worksheets are designed to learn before learning to scratch programming

(Worksheet → Scratch Programming → Physical computing). I made the content by analyzing previous studies and picked out the specific programming concepts (**sequence, looping, conditional statements, variables, lists, event handling, coordination and synchronization, keyboard input, random numbers, Boolean logic**) in Scratch Programing Education. (Figure 1)

step	Contents	Programming concepts in Scratch							
		sequence	looping	event handling	conditional statements	variables	keyboard input	lists	coordination and synchronization
0	About scratch and guidance								
1	Sprites move saying <WORKSHEETS>	•		•		•			
2	Sprites move saying <PROGRAMMING>	•		•		•			
3	To a number of the sprite is programmed to operate in a predetermined sequence <WORKSHEETS>	•	•	•		•			
4	To a number of the sprite is programmed to operate in a predetermined sequence <PROGRAMMING>	•	•	•		•			
5	Drawing different shapes <WORKSHEETS>	•	•	•		•			
6	Drawing different shapes <PROGRAMMING>	•	•	•		•			
7	Use blocks to broadcast to talk to each other sprites <WORKSHEETS>	•	•	•		•	•	•	
8	Use blocks to broadcast to talk to each other sprites <PROGRAMMING>	•	•	•		•	•	•	
9	To implement the project created a simple story <WORKSHEETS>	•	•	•		•	•	•	
10	To implement the project created a simple story <PROGRAMMING>	•	•	•		•	•	•	
11	To pass through the maze using keyboard making project <WORKSHEETS>	•	•	•	•	•	•	•	
12	To pass through the maze using keyboard making project <PROGRAMMING>	•	•	•	•	•	•	•	
13	Improve project to pass the maze <WORKSHEETS>	•	•	•	•	•	•	•	
14	Improve project to pass the maze <PROGRAMMING>	•	•	•	•	•	•	•	
15	Making funny games <WORKSHEETS>	•	•	•	•	•	•	•	•
16	Making funny games <PROGRAMMING>	•	•	•	•	•	•	•	•
17	Hamster Robot <PHYSICAL COMPUTING>	•	•	•					
18	Simply moving Hamster Robot <PHYSICAL COMPUTING>	•	•	•					
19	Moving Hamster Robot(Looping) <PHYSICAL COMPUTING>	•	•	•					
20	Moving Hamster Robot in different directions <PHYSICAL COMPUTING>	•	•	•					•

Figure 1: Worksheets Contents

Worksheets are designed to help students understand an algorithm which describes the content and implementation in Scratch programming education. (Figure 2)

Figure 2 displays five panels of Scratch worksheets:

- Q 1:** Shows a cat sprite with a speech bubble. The challenge is to make the sprite say "Hello!". It includes a table for Scripts, Blocks, and Explanation, and a question asking to select the appropriate block under the second script.
- Q 2:** Shows a flag sprite. The challenge is to make the sprite speak when the green flag is clicked. It includes a table for Scripts, Blocks, and Explanation, and a question asking to select the appropriate block under the second script.
- Q 3:** Shows a cat sprite. The challenge is to move the sprite 10 steps when the right arrow key is pressed. It includes a table for Scripts, Blocks, and Explanation, and a question asking to select the appropriate block under the second script.
- Q 4:** Shows a cat sprite. The challenge is to move the sprite 10 steps when the space key is pressed. It includes a table for Scripts, Blocks, and Explanation, and a question asking to choose the appropriate script to the first block below.
- Q 5:** Shows a cat sprite. The challenge is to move the sprite 10 steps when the right arrow key is pressed. It includes a table for Scripts, Blocks, and Explanation, and a question asking to complete the script move to "above".

Figure 2: Worksheets in Scratch programming education

III. CONCLUSION / CONTRIBUTION

We expected that students were able to enhance their programming abilities. We proved that our worksheets were suitable for elementary school students through a demonstration class.

REFERENCES

1. Jenkins, T, "On the difficulty of Learning to Program," 3rd Annual LTSN-ICS Conference, pp. 53-58, 2002.
2. Scratch Homepage, <http://scratch.mit.edu>

Information Flow Visualization in Java

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I. INTRODUCTION

Many research has been conducted on generating precise system dependency graph (SDG) to detect security leak. The informative feedback to the programmers for the security tracks is as important as the detection correctness. But, as for our best knowledge, there are a few efforts on how to visualize the security leak detection results even if those security tools used the SDG internally.

This paper proposes a united dependence visualization using multiple views for secure Java coding practices. Programmers can trace secure data with information flow graphs.

II. DEPENDENCE GRAPHS

A Program Dependency Graph (PDG) describes the data/control dependencies for a single procedure. A System Dependence Graph (SDG) extends the PDG with interprocedural calls for the whole system.

Both graphs are results from the static program source code analysis and contain nodes and edges representing each statement and dependencies among them. Many research analyzes the information flow inside the program using PDG/SDG to detect illegal flow, a violating path which might be a security leak.

III. INFORMATION FLOW VISUALIZATION

Information flow in Java must visualize 1) methods, classes, and packages, 2) abstract methods, abstract classes, and interfaces, 3) individual objects, 4) inheritance, dynamic binding, and polymorphism.

Visualizing the interactions among objects in Java is difficult in the presence of inheritance, polymorphism, and dynamic binding. This visualization includes an object's state information in a collection of variables, and object's behaviors implemented by methods that use those variables.

Through the information flow graphs visualizing forward and backward step-by-step synchronized control flow, object flow, and data flow of a Java program, programmers get a better perspective of the behavior, and interaction of the objects, and tracing the data flow along with control and object flows of the Java code.

It is anticipated that the proposed United dependence visualization helps programmers in detecting an explicit and implicit flow of secure data.

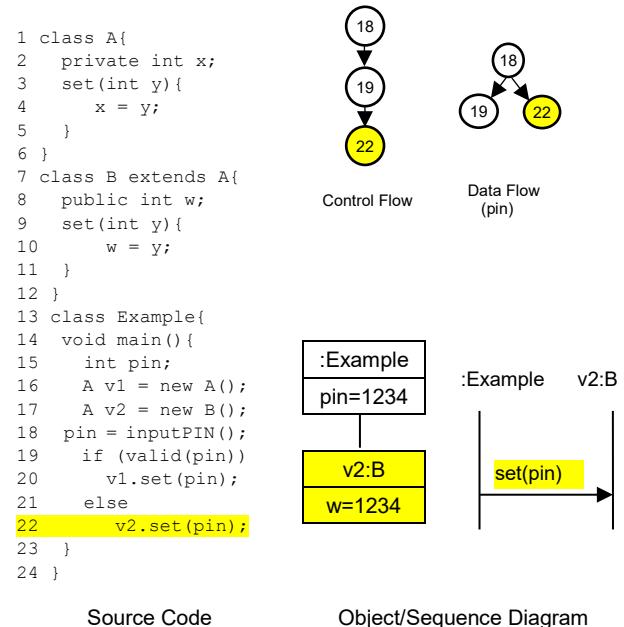


Figure 1. United Dependence Visualization

REFERENCES

1. Vinay Arora, Rajesh Kumar Bhatia, Maninder Singh, "Evaluation of Flow Graph and Dependence Graphs for Program Representation", International Journal of Computer Applications (0975 – 8887) Volume 56– No.14, 2012

A Comparative Study of Data Visualization Tools

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SUMMARY

Data is being generated very rapidly due to increased amounts of information in everyday life. Huge amount of data gets accumulated from various organizations that are difficult to analyze and exploit. Effective and efficient data visualization is the key part of the discovery process. This paper provides a survey of work in data visualization tools from various points of views.

I. INTRODUCTION

Data visualization is a process that aims for effective data communication and clarity of use to the user through graphical representation. Effective and efficient data visualization is the key to the discovery process. It is the intermediary between human intuition and quantitative context. Load the data, thus an essential component of the scientific path from data into knowledge and understanding.

We will explore and assess highly ranked data visualization tools by professionals. Through this survey, you may choose the most appropriate visualization tool by understanding data and its composition, what information you are trying to convey to your audience, and how viewers process visual information.

II. A BRIEF OVERVIEW OF DATA VISULATION TOOLS

Tableau is the leader in the data visualization space. However, there are some limitations that may point you towards another tools. There are numerous alternatives including Power BI and QlikView. Microsoft Power BI is a free, self-service business intelligence cloud server that provides technical

business users with tools for aggregating, analyzing, visualizing and sharing data. QlickView is a business discovery platform that provides self-service business intelligence for all business users in organizations. Qlik Sense is also one of the popular visualization tool. Drag and drop features in Qlik Sense are easy to use for Data Analysts, Managers and Developers.

III. FUTURE WORKS

More data visualization tools are to be explored and compared with different features. Tools should be analyzed and demonstrated with sample data sets.

REFERENCES

1. Nathan Yau, Visulize This: The FlowingData Guide to Design, Visualization, and Statistics, 1st Edition, Wiley, 2011.
2. Segel, E., & Heer, J., Narrative Visualization: Telling Stories with Data. *IEEE Trans. Visual. Comput. Graphics IEEE Transactions on Visualization and Computer Graphics*, 16(6), <http://vis.stanford.edu/files/2010-Narrative-InfoVis.pdf>

A Study on the Utilization and Module Configuration Diagram of the User Path in Virtual Reality Using Unity

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Department of Software Convergence, Kyung Hee University, Republic of Korea

SUMMARY

In the virtual reality, it is possible to track a user's moving path, collect data, and utilize it in various ways. The disaster evacuation simulation content can measure and analyze the path of movement of the user when a disaster occurs and install emergency supplies in the actual environment to improve efficiency. Also, in the case of a child, if a disaster occurs, it may get out of the building and get lost or hidden. At that time, it analyzes how children move and hide mainly, and enables a quick rescue operation when the rescue workers in an actual disaster advance the rescue operation.

I. INTRODUCTION

There were not many cases of utilizing data of the user's movement route in virtual reality. In virtual reality, information about a user's moving route can be utilized in many fields. Among them, we used the movement path information on the content of the disaster occurrence and created the module configuration system diagram as to which direction can be used and how to store the data.

II. UTILIZATION OF USER PATH

Recently, a lot of disaster evacuation simulation content using VR technology has been developed and put to practical use. Elementary, middle and high schools are promoting disaster evacuation drills through VR devices assuming various disaster situations such as fires and earthquakes. In virtual reality, it is possible for me to know how fires and earthquakes act and move through the path the user travels. By collecting this information, you can mainly know how people will move in the event of a disaster, and efficiently install emergency supplies such as emergency lights and fire hoses. Also, especially in the case of elementary school, children tend to hide like in a wardrobe, under a bed without going out during a disaster. Analysis of how to act in a virtual environment to predict actual disasters and where to find rescuers when they are expanding their rescue work, more accurate and prompt rescue work Can proceed.

III. MODULE CONFIGURATION DIAGRAM

The navigation graph auto-generation module in which there is a navigation system that produces VR content in Unity automatically switches to a call-

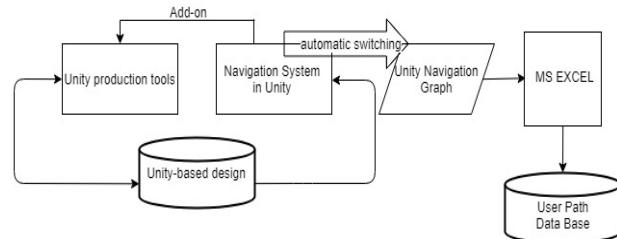


Figure 1: Module Configuration Diagram

in navigation graph (see Figure 1). As a result, data such as time required for task execution by the user, movement distance, movement locus, etc. are examined in real-time, this data is stored, extracted in the data form of MS EXCEL, and made database.

IV. CONCLUSION

We created a module configuration diagram that stores user's route data with disaster evacuation content in virtual reality. The information of path can be used to analyze the user's path, install emergency supplies in the real environment, and improve efficiency. It analyzes how the child moves mainly and enables quick rescue work when the actual rescue workers perform rescue work. Finally, how to store data with Unity created content can be used for later research by creating a module configuration system diagram. It creates evacuation VR content in the event of a fire for children under 13 years of age and adults. So we collect movement route data and compare the two groups to analyze the difference in movement route. Also, analyze the movement path of the child and, in the case of a child, analyze how it moves and why it moves in the event of a fire. And by drawing out the conclusions, we will teach the rescue workers the main movement routes of the children and create guidelines that can be quickly rescued.

ACKNOWLEDGEMENTS

This research was supported by the Korean MSIT (Ministry of Science and ICT), under the National Program for Excellence in SW (2017-0-00093), supervised by the IITP (Institute for Information & communications Technology Planning&Evaluation).

REFERENCES

1. Lijun Cao, Jing Lin, Nan Li, "A virtual reality based study of indoor fire evacuation after active or passive spatial exploration", Elsevier Ltd, Computers in Human Behavior 90 (2019), pp.37-45

Category Classification of Educational Videos on YouTube through Machine Learning Approaches using Video Titles

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SUMMARY

In this study, we built and evaluated classification models to classify educational videos on YouTube. YouTube videos' title was used for model training and testing. Our research has revealed that it is possible to classify YouTube educational videos into videos with subcategories.

I. INTRODUCTION

In the past few years, YouTube has become the trending social media platform. Especially in the field of education, previous studies have shown that YouTube videos can improve student engagement, critical awareness, and deep learning [1]. As the number of students using YouTube as educational method increases, it becomes important for learners to efficiently identify videos that meet their needs. One approach to supporting them is to classify educational videos into subcategory. In this study, we created three classifiers to classify the categories of educational videos on YouTube into subcategories and measured the performance of each classifier.

II. Method

We focused on building a classification model that classifies "deep learning" videos as "Science & Technology", and "piano" videos as "Music". First, we used YouTube Data API of Google API Explorer. The combination of keywords we used was ("Deep Learning" AND "Lecture"), and ("Piano" & "Lesson"). As of April 2019, we have collected total 3601 titles from the videos on YouTube. Then, we screened videos if the title is: 1) not written in English, and 2) text similarity is over 80%. As a result, a total of 1459 videos were selected: 529 from deep learning and 930 from piano. Among them, we used a total of 800 titles, 400 from each category. Third, we have preprocessed the text in the title to improve the accuracy of the classification model. We 1) removed all emoticons and stop words in the title, and 2) performed stemming and lemmatization. Fourth, we labeled category to each title: "deep learning" videos' title as "Science & Technology", and "piano" videos' title as "Music". Last, using WEKA software [2] as a machine learning tool, we created Naïve Bayes, SMO-based SVM, C4.5 based decision tree classifier to classify videos with stratified 10-fold cross validation.

Table1. Summary of Measured Values of Classifiers

	Naïve Bayes	SVM	C4.5
Correctly Classified Instance (%)	99.875	99.875	99.625
TP Rate	0.999	0.999	0.996
FP Rate	0.001	0.001	0.004
Precision	0.999	0.999	0.996
Recall	0.999	0.999	0.996
F-Measure	0.999	0.999	0.996

III. RESULTS

As shown in Table 1, all three different classifiers showed high performance which is over 99% of accuracy in classifying educational videos' categories. The result of this study shows that educational videos on YouTube can be potentially used to classify the categories of educational videos on YouTube into subcategories.

IV. CONCLUSIONS

This study aimed to classify educational videos on YouTube into subcategories through machine learning approaches. We built classification models to categorize "machine learning" videos as "science & Technology", and "piano" videos as "Music", and measured models' performances. One limitation of this study is that we did not check whether this method can actually support learners when they identify educational videos. Future work still remains to evaluate learners' satisfaction when they interact with classified videos for educational purposes.

ACKNOWLEDGEMENTS

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REFERENCES

1. Clifton, A., & Mann, C. (2011). Can YouTube enhance student nurse learning?. *Nurse education today*, 31(4), 311-313.
2. Weka 3: Machine Learning Software in Java, <https://www.cs.waikato.ac.nz/ml/weka/>

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III. RESULTS

As shown in Table 1, all three different classifiers showed high performance which is over 99% of accuracy in classifying educational videos' categories. The result of this study shows that educational videos on YouTube can be potentially used to classify the categories of educational videos on YouTube into subcategories.

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REFERENCES

1. Clifton, A., & Mann, C. (2011). Can YouTube enhance student nurse learning?. *Nurse education today*, 31(4), 311-313.
2. Weka 3: Machine Learning Software in Java, <https://www.cs.waikato.ac.nz/ml/weka/>

A Prototype of Non-smoking Aid Application Based On Features and User Interfaces to Support People with Low Vision

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SUMMARY

The smoking rate of disabled people is not significantly different from non-disabled people. Therefore in this paper, we identified the features and User Interfaces(UIs) of the smoking cessation aid application for people with low vision. We propose a prototype based on the features and UIs.

I. INTRODUCTION

The smartphone penetration rate for people with disabilities is 65.4% [1]. This indicates that 41% of people with visual impairment are accompanied by difficulties surveying the difficulty of using smartphones. 44.2% answered that "the environment for access to necessary information is not ready." Next, 30.2% were "most services focused on non-disabled people" [2]. Smoking rate of disabled people is 18.7%, smoking rate of non-disabled people is 22.6% [3]. In conclusion, we need an application for people with low vision

II. INITIAL PROTOTYPE

We identified the features and UIs of smoking assertion application for low vision people. First of all, as with the basic smoking cessation application, the features people with low vision need include setting goals and strengthening smoker's daily goals to strengthen smoker motivation to quit smoking. smokers also have the ability to view information about health changes according to the number of days people with low vision have smoked and the amount saved for quitting smoking. Second, People with low vision can then adjust the color in the color blindness settings. It accounts for the largest proportion of people with low vision. Third, there is loss of central vision and peripheral vision loss of symptoms of low vision. In the former case, the object appears black at the center, but the latter does not clearly show the outer part [3]. By setting, it has a features to adjust the placement of characters and features according to the symptoms.

In the application UIs, First people with low vision have a narrower vision than non-disabled people, so set features and information at one time so that many characters do not appear on one screen. Second, low vision users are difficult to read using scrolling. So instead of scrolling, We set it to sweep the screen. Based on the above results, We made a prototype.



Figure 1. Screenshots of Application Prototype

On the main screen, daily goals were placed at the center to increase motivation. Also, instead of scrolling, We made it possible to sweep the records of the day. We also created two sections that will allow you to sweep through health information for quitting time. (see Figure 1)

III CONCLUSION

We propose a prototype based on features and UIs to support people with low vision for quitting smoking. We aim to develop UIs based on symptoms by installing various features of the low vision application for smoking cessation. It is expected that he will help low vision people quit smoke. However, it is a critical point to consider only two of the symptoms of low vision. We plan to make the application considering the symptoms of blind spot, night blindness, corneal opacity, etc. in the field of vision other than the two symptoms.

ACKNOWLEDGEMENTS

This research was supported by the Korean MSIT (Ministry of Science and ICT), under the National Program for Excellence in SW (2017-0-00093), supervised by the IITP (Institute for Information & Communications Technology Planning&Evaluation)

REFERENCES

1. A Survey on the Digital Difference, Korea Information Society Agency.
2. A Study on the Information Needs and Usage Behavior of the Blind, Oh sun kyung (2010). p.55 - 59
3. Symptoms of low vision, National Health Information Portal Medical Information (<http://heath.mw.go.kr>).

Character Assisted Music Listening

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I. INTRODUCTION

We propose a character-assisted music listening system for enhancing music listening experience. It provides an audience with a virtual character of which facial expressions and head movements are animated in real-time based on the performance capture data from a human performer who has a deep understanding on the music being played. The proposed system is based on the principle of emotional contagion and aims to provide a unique entertaining experience of listening together with a virtual character. From a preliminary user study with 80 college students, our experiment has shown some positive results in enhancing the audience emotions in music listening. Based on the results, we plan to further develop the system and conduct more in-depth user studies.

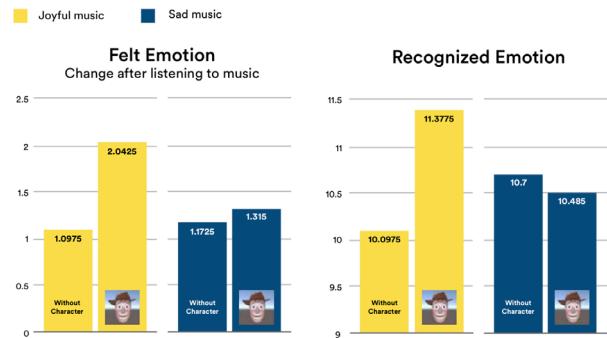


Figure 1: Character-Assisted Listening

II. PROPOSED APPROACH

Our system primarily targets a live concert setting where the audience generally looks at the stage while listening to music. The system comprises of a performance capture module for capturing facial expressions and head movements of a performer, a character-animation module for re-targeting the captured performance to a 3D character, and lastly a display module for showing the character-animation on a big screen in real-time. The music emotions captured in this way can include happiness, sadness, disgust, fear, contempt, anger, or surprise. The facial expressions of the emotions from the music are re-targeted to the virtual 3D character in real-time.

III. EXPERIMENT RESULTS



IV. CONCLUSION AND FUTURE WORK

In this paper, we proposed a new music appreciation system based on the emotional contagion principle and a virtual character. Considering the importance of the visual quality on user experience, further experiments need to be done with higher-quality animations. Future research directions include automatic character animation generation based on machine learning, where it learns a person's unique emotion model and generates facial expressions of a character synched to music such that it appeals to the person. It will provide the experience of listening along with a favorite character on a personal device.

REFERENCES

1. Hauke Eggermann and Stephen McAdams. 2013. Empathy and emotional contagion as a link between recognized and felt emotions in music listening. *Music Perception: An Interdisciplinary Journal* 31, 2 (2013), 139–156.
2. Gunter Kreutz, Ulrich Ott, Daniel Teichmann, Patrick Osawa, and Dieter Vaitl. 2008. Using music to induce emotions: Influences of musical preference and absorption. *Psychology of music* 36, 1 (2008), 101–126.
3. Emery Schubert. 2013. Emotion felt by the listener and expressed by the music: literature review and theoretical perspectives. *Frontiers in psychology* 4 (2013), 837.

An Online Learning to Improve the Fuel Efficiency of Natural Gas

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I. INTRODUCTION

Food, beer, and beverage industries consume huge amounts of natural gas in their boilers for manufacturing process. Saving even a small % of gas by improving fuel efficiency of their boilers will not only help them increase their profits but also reduce emissions and improve the air quality. It is known that variation in the natural gas fuel quality significantly affects the efficiency of the combustion process [1]. In this research, we develop an online learning algorithm that accurately estimates the fuel quality in terms of Wobbe index by measuring the physical properties of the gas such as temperature, pressure, thermal conductivity, and sound velocity.

II. HOW TO FORMAT THE PAGE

A. Sensors Data Collection

Real-time and intelligent sensors are developed to measure the physical properties. A stream of sensor data and other related data from boilers will be sent to a cloud storage using MQTT message queuing protocol implemented in an IoT device. The data will be saved on the cloud and used for analysis by visualization and training the prediction algorithm.

B. Online Learning Algorithm

The initial prediction polynomial model with order 8 for our online learning algorithm is developed using the polynomial multiple regression method. The initial model was trained using the sensor data to predict the Wobbe index. Based on this initial model, the prediction accuracy is corrected in real-time when new feedback is received using the following stochastic gradient descent method:

Repeat Until Converge {

$$\omega \leftarrow \omega - \alpha * \nabla_w \sum_1^m L_m(w)$$

}

C. Research Results

The root mean squared error (rms) for the initial polynomial regression model was about 0.211. The

polynomial model has 495 terms. To verify the accuracy, we conducted additional modeling using support vector regression with rbf kernel and random forest regression. The rms errors of the support vector regression model and random forest regression were 0.324 and 0.200, respectively.

For easier implementation and integration with the entire system, we chose the polynomial regression model as the base model for online learning.

III. ILLUSTRATIONS

Figure 1 illustrates the system architecture. A stream of sensor data from the sensor controller and data from boiler controllers will be sent to a cloud storage.

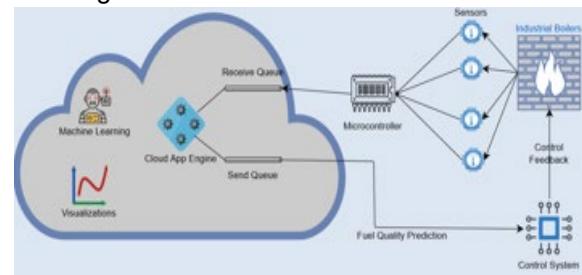


Figure 1: A system architecture

Sensor controller will communicate with boiler controller to control boiler parameters. Online learning and visualization will be conducted on the cloud. Online learning algorithm will correct the prediction model in the sensor controller when new feedback is received. This cycle repeats.

ACKNOWLEDGEMENTS

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REFERENCES

1. P. Roy, C. Ryu, and C. Park, Predicting Wobbe Index and methane number of a renewable natural gas by the measurement of simple physical properties, Vol 224, Fuel, Elsevier, 2018.

Designing home security cameras in scales

Changsoo Jeong

Head of Algorithm, Ring/Amazon

I. INTRODUCTION

AI-based algorithm design is a key factor for smart security cameras. To achieve the goal of monitoring possible security concerns, a security camera should have multiple sensors to detect a motion in the environment and fuse them into recognizable data samples. Ring is a frontier company to provide smart security cameras to send a real-time notification and live stream to users that watch and react to the possible security concerned events. Ring's AI-based motion algorithm consists of highly sensitive image sensor, strong capable SoC to process high dimensional video/sensor data, real-time video streaming system, behavioral algorithm on a cloud. I will present problems and difficulties Ring has been tackling for the smart camera system.

II. HOW TO MAKE SMART CAMERAS

A. Sensors

Ring camera uses several different sensors to obtain proper information about an object and its motion. Earlier Ring camera heavily uses PIR (Passive Infra-Red) sensor to detect a motion due to the low power consumption and high sensitivity for battery operated models. PIR is low powered and highly sensitive sensor to detect up to 50ft away objects. At night, PIR sensor can detect a motion without any visible light. For more powerful Ring cameras, an image sensor can provide more information about environment. Due to having multi-sensors in Ring cameras, each sensor's limitation will be compensated each other.

B. Algorithms

For battery operated devices, multi-PIR motion algorithm will serve to detect and stream motion events. A CNN-based CV (Computer Vision) algorithm associated with PIR sensor is using to detect and validate for particular object type, like human or pet. Ring is focusing edge-based motion algorithm since it is cost effective and data independent solution. In cloud, Ring is processing a long term, behavioral and activity-oriented analysis.

C. Real-time notification and streaming

Ring camera provides real-time notification/streaming based on UDP/RTP streaming using FreesSwitch so a user can receive and watch and communicate with a live streaming video. Ring's streaming pipeline is serving minimum latency, adaptable and high quality live streaming video and recording.

III. DATA PIPELINE

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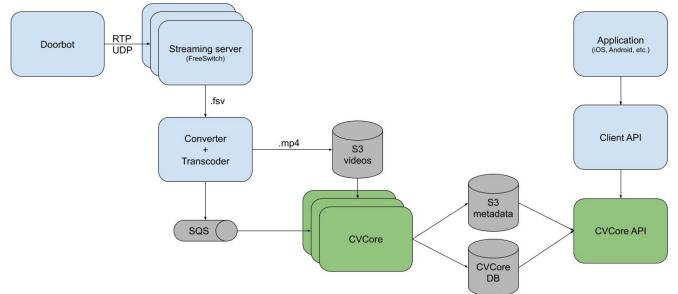


Figure 1: Ring's streaming system

REFERENCES

1. Won Ho Kim, "A vision-based system for intelligent monitoring: human behavior analysis and privacy by context," *Annual Int'l Conference on Intelligent Computing, Computer Science & Information Systems (ICCSIS-16)*
2. Tan Zhang, Aakanksha Chowdhery et al, "The design and implementation of a Wireless Video Surveillance System," *Proceedings of the 21st Annual International Conference on Mobile Computing and Networking, September 07-11, 2015, Paris, France*