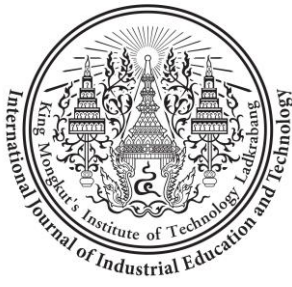




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Editorial Statement

I, as an editor in chief of International Journal of Industrial Education and Technology (IJET), would like to welcome and present you the third issue which is mainly to offer the research contents and articles in the fields of industrial education including education and technology. This IJET issue consists of a review article on low-cost robotics, a book review on cultivating creativity through projects, passion, peers, and play author: Mitchel Resnick, foreword by Ken Robinson, and a research article on Thai herbs application, respectively.

On behalf of the editorial boards, I would like to invite you to read all interesting content authored by a professional and intelligent group of writers who are volunteers to share their outcomes of research and professional discussions. Moreover, I would like to sincerely delight to thank you very much for your kind support. If you would like to make us the comments and give us the suggestions regarding on this issue, I would be appreciated and sincerely accepted that to make things better.

With best regards,



Assistant Professor Dr. Prasert Kenpankho, D.Eng.

Editor in Chief

International Journal of Industrial Education and Technology (IJET)

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Review Article

LOW-COST ROBOTICS

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ABSTRACT

Nowadays, robotics is increasingly popular in industry, education, and robot competitions. In education, robotics combines study, design, construction, operation, and use of robots. Robotics is deemed to promote students' interest. However, not all students have the access to robotics, especially in Thailand. This review article presents the information and implementation of low-cost robotics in an Arduino robotics control. The reviewing shows that low-cost robotics are beneficial for the students to exercise students' skills particularly on low-cost robotics applications and robotic education can be explored.

Keywords: Robotics; Low-cost robotics; Arduino robotics control

I. INTRODUCTION

Robotics is an interdisciplinary learning of engineering and computer science. Robotics involves study, design, construction, operation, and use of robots. The objective of robotics is to design machines that can help and assist humans. Robotics combines fields of electrical engineering, computer engineering, mechanical engineering, software engineering, etc. The use of robotics can engage students in playful collaborative problem serving activities. Robotics can serve as cognitive learning tool in the teaching and learning process. However, technology robotics always comes with a high cost. One of concerns is that school and students will struggle with the financial budget of robotics. This is a need to create awareness on the important knowledge and it can be done in the low-cost robotics.

Elfasakhany et al. (2011, pp. 47-55) designed and developed a competitive low-cost robot arm with four degrees of freedom. The low-cost robot worked as designed and moved with four degrees of arm freedom as the prospective goal. Junior et al. (2013, pp. 1-7) constructed a low-cost and simple Arduino-based educational robotics kit. They succeeded in the development of educational robotics by using Arduino and applied the robotics in the educational kit. Plaza et al. (2016, pp. 1-4) designed and constructed a collaborative robotic educational tool based on programmable logic and Arduino. In addition, Eguchi (2016, pp. 692-699) used the RoboCupJunior for promoting STEM education, 21st century skills, and technological advancement through robotics competition. Plaza et al. (2017, pp. 132-136) presented home-made robotic education, a new way to explore. Darrah et al. (2018, pp. 107-110) designed and developed a low-cost open-source robotics education platform which was useful for teachers and students in school on the minimum components in a low-cost

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robotics. Plaza et al. (2018, pp. 1-8) used Arduino as an educational tool to introduce robotics. Chicas et al. (2019, pp. 379-383) developed STEM competences by building low-cost technology robots. Ong and Ling (2020, pp. 467-473) constructed low-cost educational robotics car to promote STEM learning and 21st century skills. Rajapakshe and Hettiarachchi (2022, pp. 71-76) designed, constructed, and developed a research oriented low-cost robotics platform with a novel dynamic global path planning approach. As a reviewing, there is a collaborative robotic educational tool based on programmable logic and Arduino (Plaza et al., 2016, pp. 1-4) and Junior et al. (2013, pp. 1-7) constructed a low-cost and simple Arduino-based educational robotics. The reviewing shows a new way to explore the robotics on home-made robotic education (Plaza et al., 2016, pp. 1-4) In addition, it is very important to use Arduino as an educational tool to construct robotics as a low-cost robot (Plaza et al., 2018, pp. 1-8). Moreover, Rajapakshe and Hettiarachchi (2022, pp. 71-76) presented the construction low-cost robotics and designed the methodology to estimate the manufacturing overhead in building the robots.

This review article presents the implementation of low-cost robotics in an Arduino robotics control. The reviewing showed that low-cost robotics were created particularly on low-cost robotics applications. The information is to identify the minimum components to build low-cost robotics that can be explored.

II. LOW-COST ROBOTICS

Low-cost robotics is a minimum component to build a robot that can meet the needs of work, study, and competition. As we know that technology robotics always comes along with a high cost. One of concerns is that school and students will struggle with the financial budget of robotics. This is a need to create awareness on the important knowledge and it can be done in the low-cost robotics. In Table 1, the minimum components to build low-cost robotics are presented as the requirements and the result as a cost in Bahts. The components for low-cost robotics are single-board computer/central processing unit (CPU), graphic processing unit (GPU), actuators, cameras, additional sensors, wireless devices, and power supply. In the table, there are different robotics models that need the minimum components or required components in different objectives and goals.

According to the Table 1, there are six models of robotics, TurtleBot 3 (Burger), ROSbot 2.0, Jet Racer, JetBot AI Kit, DuckieBot (DB19), and AlphaBot2 +Intel ealSense +AnkerPowerCore II. There are ROSbot 2.0 and AlphaBot2 +Intel ealSense +AnkerPowerCore II that are full components to build the robotics. However, ROSbot 2.0 cannot be a low-cost robotics because of high cost. So, AlphaBot2 +Intel ealSense +AnkerPowerCore II can be easily called as a low-cost robotics. For the models that used the minimum components to build robotics, there are Jet Racer, JetBot AI Kit, and DuckieBot (DB19). They are low-cost robotics but JetBot AI Kit and DuckieBot (DB19) are low-cost robotics with lowest cost. For TurtleBot3 (Burger), it can be a low-cost robotics but it is only one model that does not have a camera. So, in this case, TurtleBot 3 (Burger) is not low-cost robotics when compares to Jet Racer, JetBot AI Kit, and DuckieBot (DB19). Moreover, concerning only on the minimum components and cost of building the robotics, there are two out of six robotics models that are low-cost robotics. JetBot AI Kit and DuckieBot (DB19) are low-cost robotics on the minimum components with lowest cost.

TABLE 1: The minimum components to build low-cost robotics.

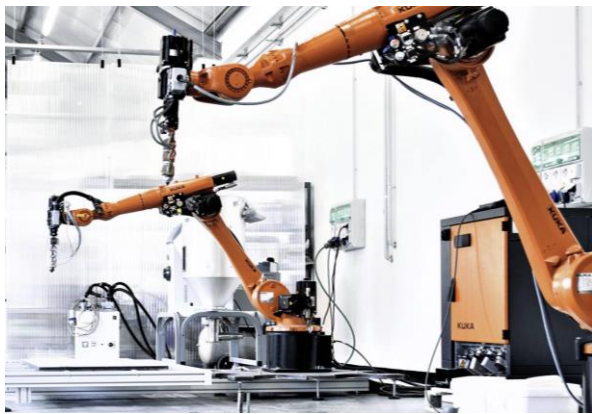
	TurtleBot3 (Burger)	ROSBot 2.0	Jet Racer	JetBot AI Kit	DuckieBot (DB19)	AlphaBot2 +Intel RealSense +AnkerPowerCore II
Single-Board Computer /CPU	Raspberry Pi 3	Asus Tinker Board with Rockchip RK3288	Nvidia Jetson Nano	Nvidia Jetson Nano	Raspberry Pi 3 Model 3	Raspberry Pi 4 Model B
GPU	Broadcom VideoCore IV	ARM Mali-T764 MP2	128-core Maxwell GPU	128-core Maxwell GPU	Broadcom VideoCore IV	Broadcom VideoCore IV
Actuators	DYNAMIXEL XL430	Xinhe Motor XH-25D	37-520 DCgearmotor Reduction rate 1:10 Idle speed 740RPM.MG996R 9kg/cm torque	TT motor Reduction rate 1:48 Idle speed 240RPM	Two DC motors with (Hall effect sensor based) wheel encoders	N20 micro gear motor reduction rate 1:30, 6V/600RPM
Camera	N/A	Orbbec Astra RGBD camera	Sony IMX219, 8MP, 160 FOV wide angle camera	IMX219 8MP, 160 FOV Wide angle camera	FBA RPi Camera (F)	Intel RealSense D435
Additional Sensors	360 LIDAR (HLS-LFCD2)	RPLIDAR A2 laser scanner, MPU 9250, VL53L0X, 4 x quadrature encoders	N/A	N/A	N/A	Reflective infrared photoelectric sensor (ST188) Reflective infrared photoelectric sensor (ITR20001/T)
Wireless	2.4GHz 802.11n wireless	802.11 b/g/n with upgradable IPEX antenna	2.4GHz / 5GHz dual-band WiFi, Bluetooth 4.2	2.4GHz/5GHz dual-band WiFi, Bluetooth.2	Edimax AC1200 EW-7822ULC 5 GHz wireless adapter	2.4 GHz / 5.0 GHz IEEE 802.11ac wireless,Bluetooth 5.0,BLE
Power Supply	Li-Po Battery 1.1V 1800mAh	Li-on batteries: 3 x 3500 mAh	12.6V, 18650 battery x 3	12.6V, 18650 battery x 3	RAVPower Portable Charger 10400mAh	Anker PowerCoreII 10000 mAh
Cost (Bahts)	21,863.7	68,449	14,147.1	10,789	10,789	13, 254

III. LOW-COST ROBOTICS METHOD

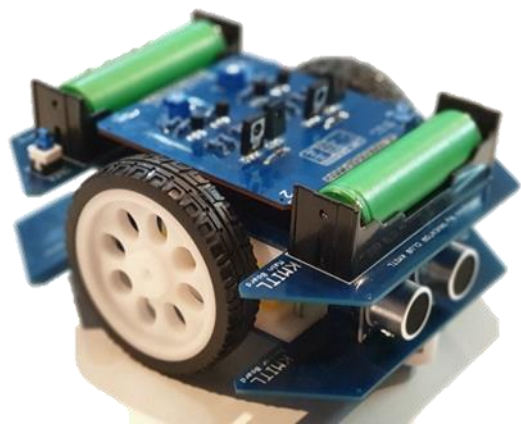
Rajapakshe and Hettiarachchi (2022, pp. 71-76) presented the idea of construction low-cost robotics and designed the method to estimate the manufacturing overhead in building the robots for three steps as follows

1. Robotic Platforms: RP
2. Robot Operating System: ROS
3. Manufacturing Overhead: MO

Firstly, RP is the platform that needs to be defined. There are many platforms in the robotics markets, however, there are three platforms in general, industry, education, and robotics racing. as shown in Figure 1. Secondly, ROS needs to be designed and recommended by using Arduino as a robot operating system. Finally, MO is the last important one with the estimated cost for manufacturing and additional matters. After three big steps, low-cost robotics method is required to follow the minimum components including single-board computer/central processing unit (CPU), graphic processing unit (GPU), actuators, cameras, additional sensors, wireless devices, and power supply.



(a)



(b)



(c)

Figure 1: Robotics platforms in (a) industry, (b) education, and (c) robotics competition.

IV. ARDUINO LOW-COST ROBOTICS

Junior et al. (2013, pp. 1-7) constructed a low-cost and simple Arduino-based educational robotics kit. They succeeded in the development of educational robotics by using Arduino and applied the robotics in the educational kit as shown in Figure 2. In addition, Plaza et al. (2016, pp. 1-4; 2017, pp. 132-136; 2018, pp. 1-8) designed and constructed a collaborative robotic educational tool based on programmable logic and Arduino.

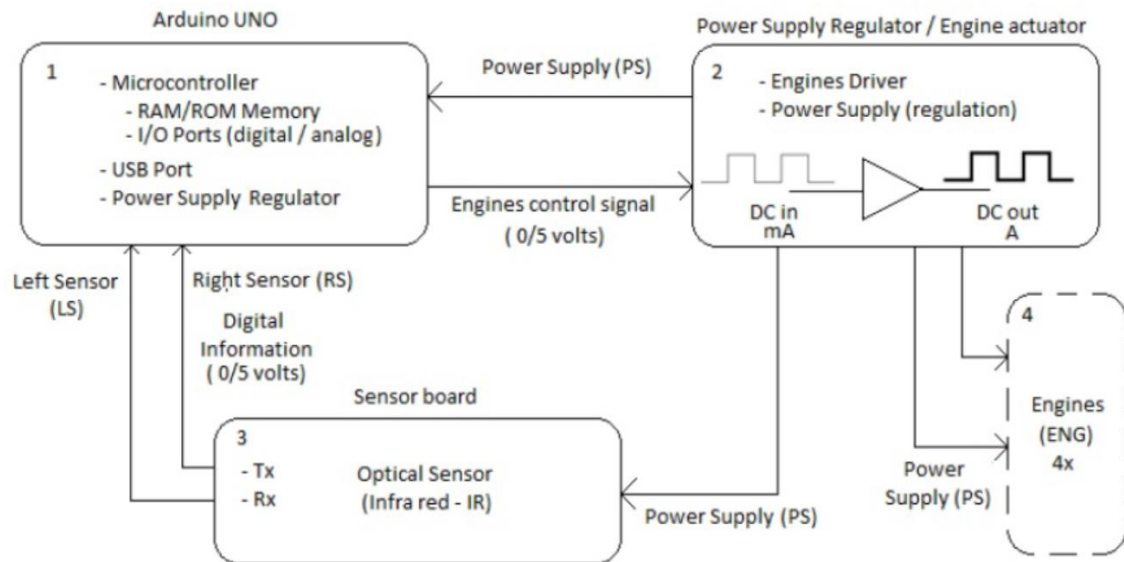


Figure 2: Simple Arduino low-cost robotics components.

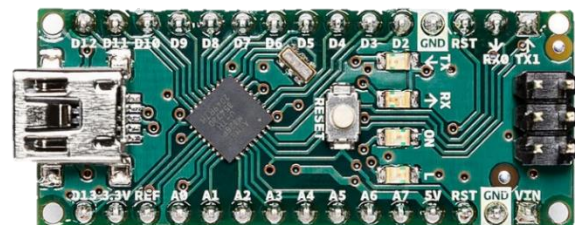
Source: Junior et al. (2013, pp. 1-7)

There are three components that are considered in Arduino low-cost robotics, Arduino board, regulator and actuators, and sensor board. Arduino board as recommended by Arduino UNO board as an open-source microcontroller board including with microcontroller, USB ports, and power supply regulator. For regulators and actuators, there are engine drivers and power supply for all components as regulation. Sensor board consists of designed sensor such as optical sensor, camera (if needs), and as required.

The advantage of Arduino is low-cost and open-source microcontroller with well documented learning. Arduino can work with different operating systems such as Windows, Macintosh OSX, and Linux. There are favorite models on Arduino are Arduino Uno Rev3, - Arduino nano, Arduino MEGA, NodeMCU (ESP8266), and Node32Lite as shown in Figure 3.



(a) Arduino Uno Rev3



(b) Arduino Nano



(c) Arduino MEGA



(d) NodeMCU (ESP8266)



(e) Node32Lite

Figure 3: Favorite models on Arduino for low-cost robotics.

V. CONCLUSION

This review article presents the information on robotics and implementation of low-cost robotics in an Arduino robotics control. The review article is to identify the minimum components to build low-cost robotics that can be explored. The reviewing showed that low-cost robotics were created particularly on low-cost robotics applications which were beneficial for the students to exercise students' skills particularly on low-cost robotics applications and robotic education can be explored.

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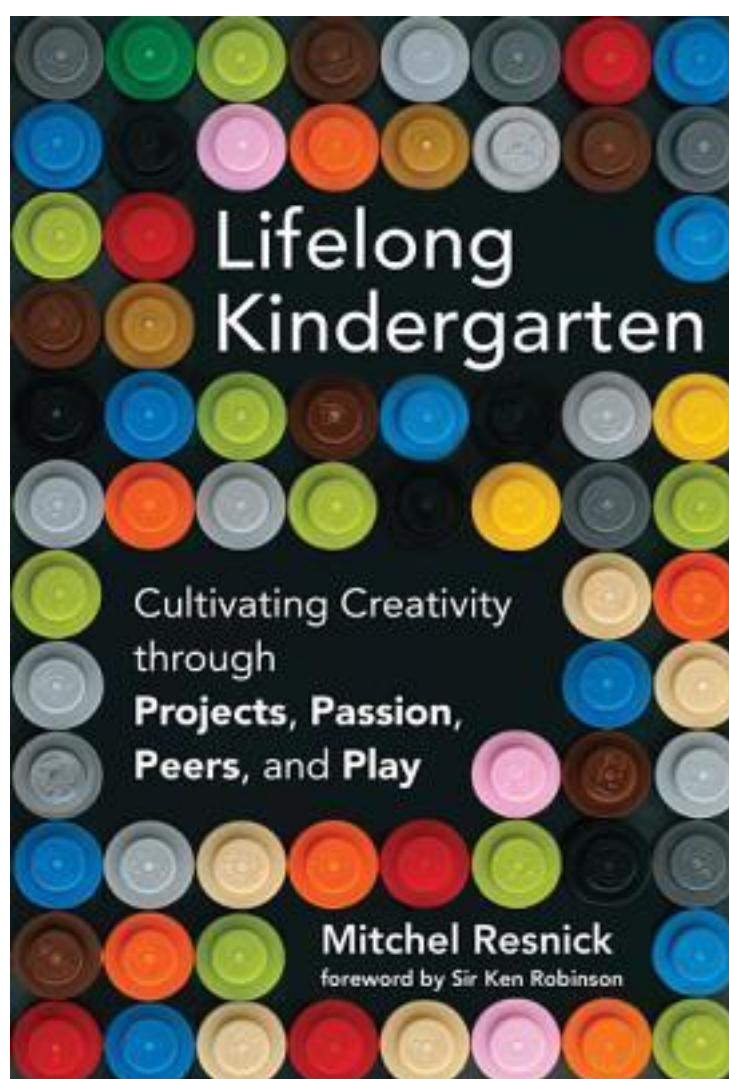
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Book Review

BOOK REVIEW: LIFELONG KINDERGARTEN
CULTIVATING CREATIVITY THROUGH PROJECTS, PASSION, PEERS, AND PLAY
AUTHOR: MITCHEL RESNICK, FOREWORD BY KEN ROBINSON

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What would the educators of the future look like? As an educator, our objective is to ensure our students thrive in tomorrow's uncharted and hazy future. In an era where technologies like artificial intelligence are the norm, and ed-tech companies evangelizing personalized learning strive to automate teachers out of their work with AI, how might we prepare the students of today to be the facilitators of tomorrow?

One of the men charting this inconceivable future for educators is Mitchel Resnick, the director of the Lifelong Kindergarten group at the Massachusetts Institute of Technology (MIT) Media Lab. His answer is crystal clear: creativity must be at the heart of how we educate, evaluate, and empower our pupils. We'll be reviewing his critically-acclaimed publication, "Lifelong Kindergarten: Cultivating Creativity through Projects, Passion, Peers, and Play", to examine how we can utilize creativity for students to build their own learning journey.

There are six chapters in this book: Creative Learning, Projects, Passion, Peers, Play, and Creative Society. These chapters are largely based on his life's work and experiences at the Lifelong Kindergarten research group. Instead of striving to produce Grade-A students with perfect test scores, the objective of creative learning is to imbue the next generation of X-students with the spirit of creativity and innovation, as automation continually transforms the careers of the future and communities of tomorrow will be facing problems where textbook solutions are inadequate.

In the first chapter, Creative Learning, the author analyzes the philosophy behind the creation of the kindergarten, which originates from Froebel's Gifts, a set of constructive toys that develops understanding via re-creation and play, which empowers children to think in a multi-disciplinary way at a young age, entangling design and engineering together. His analysis results in the Creative Learning Spiral, a description of the creative process of learning through play and experimentation, starting from imagination, creation, playing, sharing, and reflection. This closely resembles how innovation is being developed in the industry, such as build-measure-learn in Lean Startup or Design Thinking.

In the next four chapters, the author describes the 4Ps of creative learning: Projects, Passions, Peers, and Play. Throughout this book, the author uses the example of MIT Media Lab's Scratch application on how the Lifelong Kindergarten research group builds a virtual environment for students around the world to create and collaborate; he breaks down how each of the four components play a crucial role in how we can build environments that nurture and empower student's creativity.

Instead of passively consuming the information broadcasted by the teachers and solving quizzes on the textbook, projects change the role of students into maker of things and builders of knowledge. Learning through projects allows students to be multi-disciplinary, utilizes the connection between domains of knowledge, and develops the problem-solving strategies. Students who learn through projects naturally become fluent in computational-thinking strategies (i.e. decomposition, abstraction, debugging), and are able to clearly express their ideas and identities.

The author then shares the story of the students in the Computer Clubhouse in the third chapter, "Passion", and how their passion originates from their interest in their hobbies, technologies or life experiences, which becomes the key intrinsic motivation that drives their projects forward. He then highlights the importance of "wide walls", designing learning environments that support a wide variety of projects to support their creative processes. He criticizes how the current implementation of gamification and personalized learning does not utilize students' passions and only becomes an ineffective extrinsic motivation.

Through passions shared among their peers, collaboration emerges at various scale; from students collaborating on the same projects in extended teams, to entire sub-communities built around students with the same interest contributing their own projects to the bigger theme. The fourth chapter, Peers, indicates how some forms of collaboration in Computer Clubhouse and Scratch can be nurtured by facilitators, while the rest emerge organically through students' passions. The author advocates for the "hacker culture" of remixing, caring and openness; this trend aligns well with the modern open-source software and maker movement, such as how OSS contributions are done asynchronously in GitHub with issues and pull requests.

The fifth chapter, Play, extricates open-ended, imaginative, and experimental play (playgrounds) from strictly-defined and structured play (playpens). Playfulness defines the philosophy of the hacker culture, as the tinkering process is second nature to hackers: messing around with the environment, utilizing accidental findings to your advantage, inferring from your experiences, and hacking your tools to do what it is not designed to do; tinkering is an incremental, iterative, creative, and agile process. The author emphasizes on how well-designed playgrounds should support diverse styles of learn and play, as well as normalizing mistakes and failure as the part of the creative process.

The final chapter discusses the importance of building a Creative Society, as students in the current education system are discriminated based on their styles of learning and stripped of their identities, imagination, and creativity. Mitchel shares his idea on how to practically implement his idea, such as how to balance structure and freedom and when to switch between each of the four roles. My top five favorites tips are: 1) being matchmaker to help students connect with others, 2) encouraging students to engage in multiple types of making, 3) asking students to share strategies and source of inspirations, 4) forming collaboration with students on shared projects, and 5) sharing your own reflections and asking the right questions.

As an educator, we must re-think our roles as catalysts, consultants, connectors, and collaborators. While we cannot and must not enforce what exactly the students will learn or the solutions that they will build, we have an important role to spark their imagination, provide emotional and technical support, bridge the learners together, and collaborate with them; this empowerment plays a great role in how students develop their creative processes.

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Research Articles

THAI HERBS APPLICATION

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ABSTRACT

The purposes of this research were to develop Thai Herbs Application. The target group was the three experts into the development of application to evaluate the effectiveness of the application. The tools of this research were 1) Thai Herbs Application and 2) Evaluation form of Thai Herbs Application. Statistics used were mean and standard deviation. The research findings showed that an Thai Herbs Application helped facilitate the search using by photos and be used on smartphone that ran android operating system and predicted herbs photos by Auto ML Vision API. The Thai Herbs Application is divided into two parts. The first part is Mobile Application section. The ability of the application can search for four ways, including 1) camera, 2) pictures album, 3) herbs name, symptoms or diseases, and 4) voice. The second part is web application for administrator section to manages information such as herbal information, symptoms and diseases, contraindications and precautions for using herbs, and herbal medicine information. The results of the Thai Herbs Application performance evaluation was found that the overall result of the research was at the highest level, with the highest average (\bar{X}) = 4.46 and standard deviation (S.D) = 0.47.

Keywords: Applications; Search; Herbs; Photos

I. INTRODUCTION

Herbs are product of nature along with Thai society for a long time. There are many benefits that can be made into food ingredients, medicine, health care and many others (Ministry of Public Health, 2016, pp. 1-5). After the advancement of science and technology, the main of drug production has switched to chemicals than using herbs for treatment, as a result, the popularity of the herb dropped significantly which causes the knowledge of herbs to decrease. However nowadays the Thai government has a health policy that encourages people to be healthy both physically and mentally and promoting the development of biodiversity values and local wisdom.

From the aforementioned reasons, most people have focused on Thai wisdom about the use of many herbs because it has medicinal properties used in treatment and believed to have safer to use than modern medicine. In addition, the environment of Thailand is rich and diverse with plants. So, there is a lot of research and development going on to build knowledge of herbs to the released public many. It can be easily accessed such as documents, texts, books, websites, or applications that are used on smartphones,

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most of which are information in a manner that has advantages, such as cost of searching for information, storage, and the major problem in searching information is that the herbal name must be known to be able to search for that herb. In order to verify the herbal information correctly or not is difficult, it requires a specialized herbalist.

However, the advancement of technology has reduced many problems. It also has created more convenience, the one of technologies, that is machine learning. It is currently popular to use for image classification. Machine Learning is a branch of artificial intelligence developed from the study of recognition. It involves the study and creation algorithms that can learn data and predict data. The Machine Learning algorithm works based on a model built on the incoming trained dataset for further predictions or decisions replace work from step by step of computer programs and nowadays ordinary the computers programs can display images only and it cannot interpret or understand of the image.

Based on the above problems and sources, the researchers have the idea of solving and helping those interested in herbs to replacement for modern medicine by developing an application (app) to search herbs from photos. The researchers expect it can be increase the search channels of herbs to be more convenient and faster. It uses a machine learning technology known as Google 's Cloud Vision API to Image analysis. It is applied to the app to search for herbs from photographs and display information from the machine learning analysis, including herbal names, common names, scientific names, local names, general characteristics, pictures of herbs, therapeutic benefits, symptoms, and search by typing keywords such as herbal names, therapeutic properties, symptoms or diseases, as well as search from voice by speaking through the application. The research objectives are (1) to develop an application to search for herbal information from photographs and (2) to measure efficiency application to search herbal information from photographs.

II. LITERATURE REVIEW

In this research to achieve research objectives and can use it effectively and can provide information to users correctly. The researchers had studied the theoretical concepts for use in this research, including;

i. *Machine Learning (ML)*

ML is the use of algorithms to classify and analyze data by learn from the data for create a model to predict the decisions or develop software to do the procedure prescribed by using methods of teaching machines to learn from The respective dataset (Liakos et al., 2018, pp. 1-29).

ML is the application of statistical models to computer-based data (Thai Programmers Association, 2018, Online). It is the best tool today to analyze, understand and shape data. The one of main concepts under ML is to teach computers to recognize information automatically. It uses data to pass into an algorithm that can understand the relationship between the input and the output at the end of learning a machine can predict new information (Engel et al., 2019, pp. 1-4).

Machine learning and image classification

Machine learning image analysis has been applied in many areas. For example, in archeology, including labeling, classification of artifacts, coin collections. The classification of the architectural architecture of the ancient pagoda (Phaudphut, 2018, Online) are agricultural examples such as the detection of plant diseases, detect weeds livestock management, water management and soil management (Phongchit, 2018, Online).

ii. *API information from images.*

Nowadays the computers can display images but it cannot interpret or understand then means of images. The humans then created and developed MLs to help analyze images in the use of machine learning to find that image. Google currently has an image analysis API. From this study the researchers used a Google Vision® Api has and AutoML Vision® Each API provides a way for the user (Google Cloud, 2020, Online; Tangerine, 2015, Online).

a) *Google Vision API*

The Google Vision API is a machine learning service that reviews and extracts images, and has an OCR component that inspects text from images. The user can test by go to <https://cloud.google.com/vision>. The nature of work is requested through the web service (REST) the api and encrypted data in its original format base64 encode to the server of a Google (Phongchit, 2018, Online). From the server analyzes the image and when the analysis is completed, it will display search results into five categories as follows.

- 1) Objects are the examination of objects within the images entity detection.
- 2) Labels are to read text within images (OCR) or display search results as text.
- 3) Can work on web to check with a logo inside the image or not (Logo detection).
- 4) Properties are the analysis and color separation (Color) in the image.
- 5) Safe search is to detect inappropriate images such as pornography by using the same engine as Google safe search in Google image search.

b) *Auto ML Vision*

Auto ML vision is a Google Cloud platform service that facilitates easy of ML modeling by delivering data to the system. It trains with the technology of Google to come out as a model that can be put to immediate use. It can be activated via the REST of API in which to run the model through a REST API with the following steps.

c) *REST API*

Step 1 Make a command to convert the image to Base64 format.

```
try
{
    val imgString:String! = Base64.encodeToString(getBytesFromBitmap(bitmap!!), Base64.NO_WRAP)

    val requestBody = ModelRequestBody(PayloadRequest(ModelImage(imgString)))
    Network(baseUrl: "https://automl.googleapis.com/v1beta1/", tokenName: "$token_name", enableLog: true)
```

Figure 1: Convert the image to the Base64 format.

Step 2 Make a command to send pictures to <https://automl.googleapis.com/v1beta1/projects/project-automl-vision/locations/us-central1/models/titl> data models that have the Train successful example in Figure 2:

```
Execute the request

curl -X POST -H "Content-Type: application/json" \
-H "Authorization: Bearer $(gcloud auth application-default print-access-token)" \
https://automl.googleapis.com/v1beta1/projects/project-automl-vision/locations/us-central1/models/ICN2527419763808761060:predict
```

Figure 2: A data model that can be classified as the Train successfully completed.

Step 3 Write command to execute API through REST API.

```
val imgString:String! = Base64.encodeToString(getBytesFromBitmap(bitmap!!), Base64.NO_WRAP)

val requestBody = ModelRequestBody(PayloadRequest(ModelImage(imgString)))
Network(baseUrl: "https://automl.googleapis.com/v1beta1/", token_name: "$token_name", enableLog: true).getRetrofitClient
    Callback<PayloadResult> {

    override fun onResponse(call: Call<PayloadResult>?, response: Response<PayloadResult>?) {
        if (response!!.isSuccessful) {
            Log.d(tag: "Hello", response?.body()?.toString())
            val Label = "${response?.body()?.items?.first()?.displayName}"

            retrieveJSON(Label)
        }
    }
}
```

Figure 3: Write commands to execute the API through the REST API.

III. METHODOLOGY

i. Research tools

- a) Application to search herbal information from photos.
- b) Performance appraisal Application to search herbal information from photos.

ii. Target group

Expert developer applications of three people to assess the performance image applications.

iii Research procedures

The researchers divided the research into five steps as follows.

a) Analysis

In this analysis process, the researcher has studied to develop an application to search from photos, text and to know the need for apply information technology to manage information about medicinal plants correctly and setting the purpose measurement and evaluation.

b) Design

The design phase is where the researcher uses the results of the analysis to design a photo-based herb search application, application performance assessment form, knowledge, and present information about medicinal plants divided into three parts as follows;

1) Application capabilities

The researchers designed the capability of the application into two parts include user and the administrator as follows;

General users

The users can use the application via smartphones/tablets running Android kitkat 4.4 or higher by downloading the Thai Herbs application to install on the device. The users can search for herbal information from photography, photo album, and herbarium name by typing or voice. They can search for medicinal plants with general characteristics or therapeutic properties based on symptoms or diseases.

Administrator

The administrator can add/edit/delete plant information such as medicine, recipes, other information, and show the status of herbs that have not been images taken for Machine Learning to learn in the Image Search API.

2. Design a user interface

The researchers had designed the user interface screen which is divided into two parts application and website as follows;

Application part contains the main page of the app, searching for herbs by photo in the shooting mode, and accessing by typing in the herb name. The output section includes show herbal information, treatment information precautions for use, search for herbal information by symptoms or properties, and website section for information management system.

Website part contain of the information management herbal consists of a login, main menu, information management, lists the herbs in database, symptom/disease display, adding symptoms/disease information, show contraindications and precautions, lists formulation of the additional drug information, and administrative management.

3. Database Design

Database design of application for photos herbs from the research database was designed using entities relationship model feature.

List of entities upon completion of the design phase is complete, the researcher leading the design was designed entities recognize innovation in all six entities which contain herbal data lineage information, symptoms and diseases, contraindications and precautions pharmacopoeia information, and admin information.

ER-Diagram when designing entities completed. The researchers designed the ER-Diagram as shown in Figure 4.

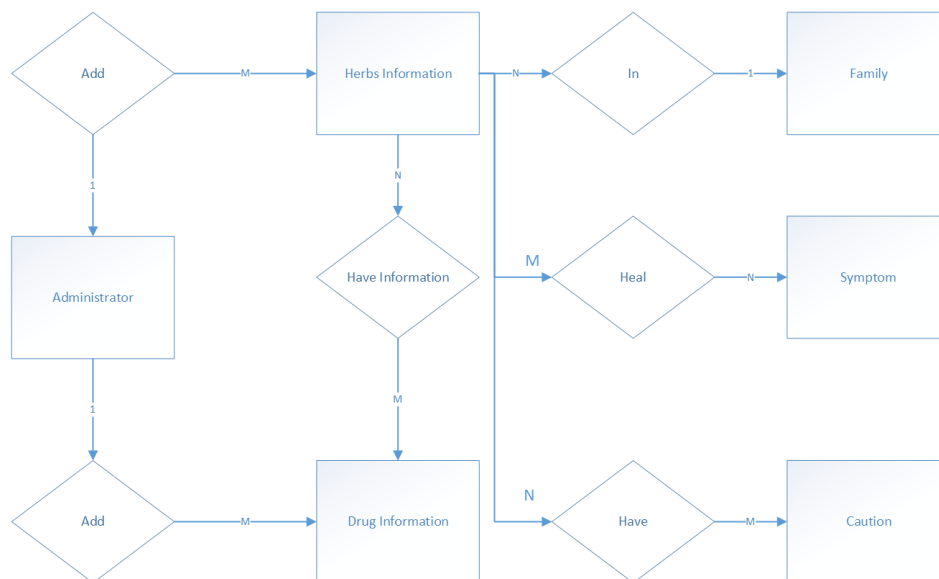


Figure 4: ER-Diagram of application to find herbs from photos.

Mapping Table

Once the ER-Diagram design was complete, the researchers had mapping tables. A total of eight tables contained the administrator, herbal, family information, symptom and disease information, formulation information, herbal properties, ingredient, and contraindications.

Data Dictionary

From ER-Diagram designed a total of eight data tables, the researchers had added a table of administrators, resulting in a total of nine tables of data as follows;

Table 1: shows the tables in the application database for finding herbs from photographs.

No.	Table name	Stored data	note
1	Herbs	Medicinal plant information	
2	Family	Family information	
3	Symptoms	Symptoms and disease information	
4	Formularies	Pharmacopoeia information	
5	Warnings	Contraindications and precautions	
6	Careful	Medicinal properties	
7	careful	Information, herbal advice	
8	Ingred	Information on ingredients of traditional medicine	
9	User	System Administrator	

Development

When the researchers had finished designing an application to search for herbs from photographs. The researchers took the part that had been designed for development which had the following development steps;

Algorithm design

The researchers designed the algorithm of the application into three parts as follows;

1. Save information about herbs such as herb description, symptoms/diseases, information, contraindications and precautions, and information pharmacopoeia.
2. Upload the image to the Image Search API and input herb's name of the image according to the herbal science name in the database.
3. Select a search type.
 - Find the image.
 - 1) Upload image.
 - 2) Find Herbal Info from images using Image Search API.
 - Search by typing the name, herb, symptom or disease
 - 1) Enter the name of the herb, symptom or disease.
 - 2) Search for herbal information by typing the herbal name, symptom or disease. corresponding to the search term in item 1.
 - Search by speech, herbal name, symptom or disease.
 - 1) Name the herb, symptom or disease.
 - 2) Convert speech to text using Speech Recognition.
 - 3) Find herbal information from text converted from speech.

Herbs Information Management System

The researchers designed the herbs information management system that can be manipulated add/search/edit/delete by web application included herbal information, symptoms/disease, contraindications, and precautions list of drug recipes.

Application part

The application part was developed that run on smartphones to facilitate and easy to use for users finding the herbal information by photos from the camera, photo album, herbal name, and symptoms of the disease.

Implementation

The implementation part is the process of bringing the application to test the use that it works properly as designed.

Evaluation

The evaluation part is evaluated the results of the experiment with three application development experts to evaluate the effectiveness of the application and to collect data.

IV. RESULTS

i. Application development results to search for herbal information from photographs.

The researchers have developed application to search herbal information from photos according to the designed research procedure by using the data from the study and analysis to create an application to search for herbal information from photos. The results of the research are divided according to the user 's part into two parts: the admin and the user as follows;

Admin section

The admin section can manage various information such as herbal information, symptoms / disease, contraindications and precautions, herbal pharmacopoeia of user management, and part of the refresh token to access the API shown in Figure 6.

Main menu

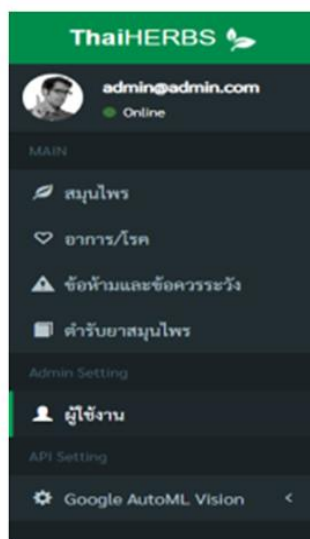


Figure 6: The screen showing the main menu of the Herbal Information Management System.










Figure 7: Screen to add symptoms / disease information.

Figure 8: The screen for adding contraindications and cautions.

รายชื่อสมุนไพร

Show 10 entries

Search:

#	รูปภาพ	ชื่อสมุนไพร	ชื่อวิทยาศาสตร์	ชื่อวงศ์	สถานะ	Action
1		กระชาย	Boesenbergia rotunda (L.) Mansf.	Zingiberaceae	✓	 
2		กระตือกไก่	Chloranthus erectus (Buch.-Ham.) Verdc.	Chloranthaceae	✓	 
3		กระถิน	Leucaena leucocephala (Lam.) de Wit	FABACEAE	✓	 

+ เพิ่ม

Figure 9: Manage herbs.

User part

The user part is part of the application that runs on the smartphone for facilitate and easy to use for users. It consists of the following parts: search from camera, photo album, herbal name, and search for the symptoms of the disease shown as Figure 10.



Figure 10: ThaiHERBS application.

From Figure 10, the application screen of the user section consists of 1) Shooting menu entering the camera mode for taking the pictures of herbs that want to search; 2) Album menu is to enter the photo album to select pictures of herbs that have been taken and want to search for herb information; and 3) Herbs menu for entering the herbal search page by herbal name by typing name or sound. When user speaks and the symptom menu goes to the herbal search page by properties, symptoms or disease, shown as an example in Figure 11-15 is shown in order as follows.



Figure 11:
From camera.

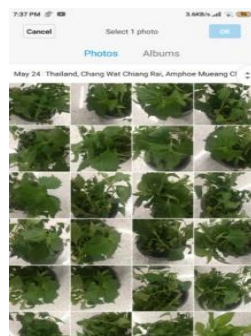


Figure 12:
From albums.

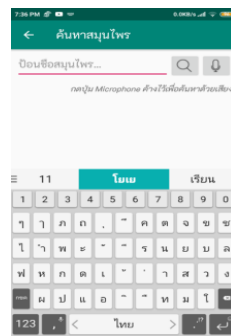


Figure 13:
From name.

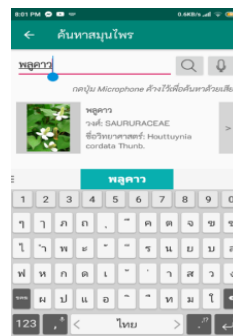


Figure 14:
From voice.



Figure 15:
From symptom.

From Figure 15, screen shots the searching by typing herbal names. The picture shows the herb search page and entering the name of the herb to search for information, press and hold the button to search by voice.

When the application searching information successfully, it will show the information as shown in Figure 16.

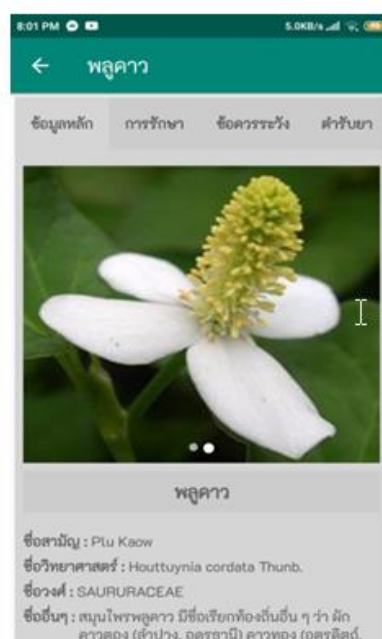


Figure 16: Herbal information screen.

ii. Verification of accuracy

In this research, the researchers examined the accuracy of the herb search by photographs. It was found that the accuracy depends on several factors from the four tests, namely the number of pictures of each herb with time to train photo clarity one herb in different locations. The search accuracy was found as shown in Table 2.

Table 2: Photo search test for herbs.

Herb	Number of pictures	Number of times in search	Search results		% Found
			found	Not found	
Cat grass	17	20	3	17	15
Cha Phlu	50	20	15	5	70
Yanang leaves	20	20	3	17	15
Pea	60	20	15	5	75
Parsley	48	20	16	4	80
Aloe vera	80	20	18	2	90
Plukaw	60	20	17	3	85
Vegetables	46	20	14	6	70

In addition, the researchers found that the duration of the train data affects the accuracy of applications, the more time it takes to train, the higher the accuracy. For example, the following example shown in Figure 17.

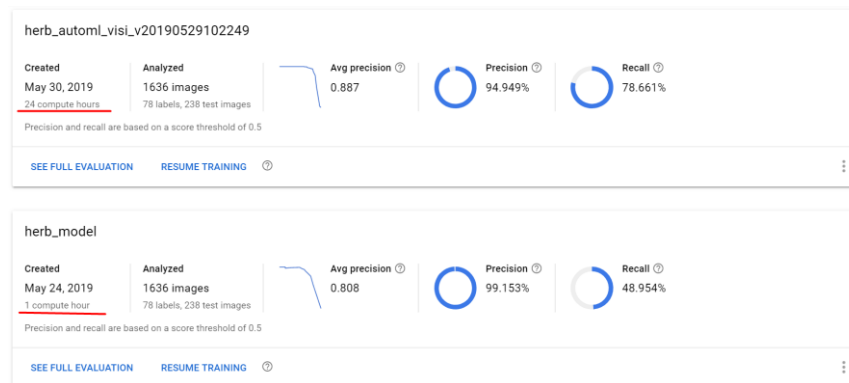


Figure 17: Comparison of data models.

iii. Evaluate performance

The researchers had submitted to the expertise of three people to assess the performance of the present studies which were analyzed using descriptive statistics and compared the results as shown in Table 3. This research has interpreted the mean efficiency results as follows.

- 4.50 - 5.00 Most effective
- 3.50 - 4.49 Very effective
- 2.50 - 3.49 Medium efficiency
- 1.50 - 2.49 Low efficiency
- 0.00 - 1.49 Minimal efficiency

Table 3: Results for evaluation of the efficacy of herbs search application by photo.

The assessment	\bar{X}	SD	Interpret results
1. The application allows the user to work with ease, use, and simplicity.	4.50	0.30	The most
2. The application is accurate and reliable.	4.54	0.37	The most
3. Applications are versatile, flexible, and multi-channel search capabilities.	4.35	0.45	very
4. The app can run continuously without errors.	4.36	0.36	very
5. Applications can be applied to a wide variety of plants.	4.54	0.37	The most
Total	4.46	0.47	The most

The results as a whole is at the highest level ($\bar{X} = 4.46$, the $SD = 0.47$) when considering issues are at the top on an application allowing users to perform convenient, intuitive, and uncomplicated. The application can be applied to a wide variety of plants ($\bar{X} = 4.54$, $SD = 0.37$), the application has the accuracy and reliability, followed by applications, functional, convenient, intuitive, and uncomplicated ($\bar{X} = 4.50$, the $SD = 0.31$), the lower levels of the application can run continuously without errors ($\bar{X} = 4.36$, $SD = 0.37$) and the application side has a wide range of capabilities, and flexible using can be searched for information in multiple channels ($\bar{X} = 4.35$, $SD = 0.45$).

V. CONCLUSION AND DISCUSSION

The Thai Herbs Application is the tool for facilitating the search of thai herbs information, divided into two parts. The first part is mobile application section. The ability of the application can search for four ways including 1) camera, 2) pictures album, 3) herbs name, symptoms or diseases, and 4) voice. It can be used on smartphone that runs android operating system and predicts herbs photos by Auto ML Vision API. The second part is web application for administrator section to manages information such as herbal information, symptoms and diseases, contraindications and precautions for using herbs, and herbal medicine information.

The results of the Thai Herbs Application performance evaluation were found that the overall result of the research was at the highest level, with the highest average was 4.46 and standard deviation was 0.47.

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ABSTRACT

-----Only One Paragraph 250-300 words-----

Keywords: Firstword, Secondword, Thirdword, Soonword

I. INTRODUCTION

-----First Paragraph for important introduction-----

-----Second Paragraph for research literature review with reference in context, APA 7th-----

-----Third Paragraph for main idea from research review with reference in context, APA 7th -----

-----Fourth Paragraph for objective-----

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5	<p>Publication</p> <ul style="list-style-type: none"> - Printed version is published as a promoted journal to associate on educational institution in public and private sector. - Online version is published on database of TCI website <p>https://ph02.tci-thaijo.org/index.php/IJET/index</p>

2. Main Research Paper Structure

Part 1 consists of

1.1 Title	English should be shortly represented on the research goals
1.2 Authors	Responded author and co-authors in English giving first name and last name but no title and referring by number.
1.3 ABSTRACT	English should be shortly focused and directly scoped on the research objective, research methodology and the research summary. It should not exceed 250 - 300 words.
1.4 KEYWORDS	English should choose keywords related to article.

Part 2 Contents

- INTRODUCTION

Including four paragraphs,

- First paragraph: Information based on articles in general.
- Second paragraph: Literature review on research/article related to the article in short
- Third paragraph: Selected research/article (from second paragraph)/methods specific related to the article in short.
- Fourth paragraph: The objective of the article. Not writing in number of objectives.

- LITERATURE REVIEW

Including two paragraphs,

- First paragraph: Review of past and present research/article related to the article in more detail.
- Second paragraph: Research data/ Hypothesis for this article.

- RESEARCH METHODOLOGY

- Should add picture, block diagram, and any graphics related to research methods.

- RESULTS (It should show the results in statistically significant according to objectives.)

- CONCLUSION AND DISCUSSION

Including two paragraphs,

- First paragraph: Conclude paragraph related to the results. Not writing in number of objectives.
- Second paragraph: Discuss the reasons of the results as it is or compare to other research's results. Not writing in number of objectives.

- SUGGESTION (If applicable) Not writing in number of objectives.

- ACKNOWLEDGEMENT (If applicable)

No needs to put the number for this content and use the same size letter

Part 3 References

- REFERENCES

The APA 7th edition reference style must be used as the requirement of International Journal of Industrial Education and Technology. The references are only referred to the research paper to be in this reference part. The writer is to be responsibility for the correction and the copyright of referring in the research.

3. Printed Format

3. Printed format

3.1 English Research Paper

Paper setting (6 - 10 pages (NOT exceed 11 pages))

- Font Th SarabunPSK only
- paper size top one inch bottom one inch left one inch right 0.8 inch

***Please follow the Template file which can be downloaded as**

3.2 Titles

In English, using the Upper case (18 Bold inch)

3.3 Author and Co-authors

It should be written in all righted authors. Identify the responded author with email.
(15 Bold inch)

3.4 Abstract and Contents

- Abstract is written in 14 bold inch and place it on the left side.
The word Abstract, only letter A is upper case and others are 14 inches with one column.
- Contents are in one column with the headline in 16 bold inches and sub headline is in 14 bold inch. The contents are in 14 inches and given in five spaces.

3.5 Keywords: Fonts size 14 inches.

3.6 Figure and Table

1. Leaving one row before inserting the table and giving one row before writing the information for the table in detail.
2. Uses "Table ..." at the left corner with font 12 bold inch.
3. Table name is in font 12 inches and if the table detail is longer than one row, it should be started with new row by the same starting column.
4. Using only in column table as opened the left and right alignments.

Table 1: (Table name is in 12 inches.)

Title (12 bold inch.)	Title	Title	Title	Title
Content (12 inches.)	Content	Content	Content	Content
Content	Content	Content	Content	Content

Figures

Figures must be clear and their height must not be less than 6 cm. Do not use the frame. Notice the "figure number" is bold and 13 point of font size. If there are the texts in the figure, please use obviously 12 point of font size.

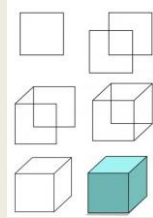


Figure 1: (Font is in 13 inches with in center column)

3.7 Conclusion and Discussion part in 16 inches.

On the left column for contents. For first row in each paragraph, it must give four word-spaces (Font in 14 inches.)

3.8 Suggestion part (If any) in 16 inches.

On the left column for contents. For first row in each paragraph, it must give four word-spaces (Font in 14 inches.)

3.9 Acknowledgement (If any) in 16 inches. Without putting number in front of topic (Font in 14 inches.) No needs to put the number for this content (font in 14 inches.)

3.10 References title font in 16 inches.

(Content font is in 14 inches.)

3.11 \bar{X} and Table Format

- Create your own table in column and Do Not Copy table form from other file sources.
- Use \bar{X} as only in this following size \bar{X} (S.D.) ($\bar{X} \geq 3.50$) ($\bar{X} = 4.51$).

3.12 Sub title format (Example)

I. Title (16 points)

A. Subtitle (Six word-spaces in 14 font inches.)

a. Second subtitle (alignment as the first world of subtitle in 14 font inches.)

1.1.1.1 Third subtitle

(1) Subtitle of 1.1.1.1

(1.1) Subtitle of (1)

4. Paper preparing /Paper submitting for publishing in International Journal of Industrial Education and Technology

For correction, perfection, and time saving, paper submission for publishing in International Journal of Industrial Education and Technology is needed to follow as this guideline.

1.1 Printed and typed in A4 paper size for 6-15 pages with one column style. By using Microsoft Word, it is highly recommended the word processing software that fits in the International Journal of Industrial Education and Technology format guideline according to our time saving for paper proof and publishing.

1.2 The original or submitted paper must be only formatted as the International Journal of Industrial Education and Technology printed format. **If NOT follow directions, the author is informed, and the paper will NOT be stepped any forward.**

1.3 Paper is needed to be clear in contents and pictures.

1.4 Paper has been Not published or Not printed in any sources such as journal, conferences, so on.

1.5 The author is fully responsibility to prove the correction of any requirement of International Journal of Industrial Education and Technology format.

1.6 Typing or writing journal application form.

1.7 Filling and signing on form to submit industrial education journal article. The first name is the author's name, then the second to sixth are advisor names and so on.

1.8 Preparing and submitting paper is noted as forms. URL at

<https://ph02.tci-thaijo.org/index.php/IJET/index>

1.8.1 Scan PDF file (.pdf) and Microsoft Word (.doc. or .docx.) to database and naming the files separately.

1.9 Completely fill out the member form of International Journal of Industrial Education and Technology. **Scan it, attach it to ThaiJo system, and post confirmed mail.**

1.10 Completely fill out the submitting form for International Journal of Industrial Education and Technology with requirement in 1.7 **Scan it, attach it to ThaiJo system, and post confirmed mail.**

1.11 For the preparing and submitting paper, please see the direction and guideline of International Journal of Industrial Education and Technology as URL <https://ph02.tci-thaijo.org/index.php/IJET/index> (Guideline is also in website).

Contact us

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5. Paper Submission is ONLY on ThaiJo

If the author DOES NOT follow as the direction, paper will NOT BE considered!

******Link....Important needs******

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*****Contact us if you have any questions*****

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