# Students' Number Detection System Using Internet of Things (IoT) Based on Image Classification Method

**Buhari, [1]Muslimin, [2]dan Lisda Ramdhani [3]**
STKIP Harapan Bima
Email : buharihari 063@gmail.com

**Abstract**
*This research aims to develop a system that can provide classroom security, design and implement a student facial recognition system in classrooms. The development of a student counting system using IoT-based image classification methods makes it easier for lecturers and teachers to document student numbers. This research uses a campus or school classroom as the case study location. The devices used include a camera or webcam module as a face detection input device, a laptop to process the camera input, validate it against the class database, and perform the identification process (using the image classification library in the OpenCV application), and a laptop that functions as a web server to display the student count dashboard page. Test results show that the system can function properly when the distance between the camera and the student's face is between 30 cm and 170 cm, and cannot count at all at a distance of 180 cm.*

**Keywords:** *Student number detection system using internet-based image classification method Internet Of Things (IoT).*

## INTRODUCTION

Technology in today's era is essentially designed to meet human needs more easily, and the current rapid technological advancements mean that almost no aspect of human life is exempt from its use, either directly or indirectly. With the current globalization and the demands for rapid information exchange, the role of communication technology is crucial in everyday life.

Counting the number of students in a room is no easy task, especially in a room with a large number of students. Manually detecting and counting students is undoubtedly challenging for lecturers and teachers, and errors are likely to occur.

Therefore, a system is needed to detect the number of students, record and process the number of students every day. So that student trend data can be known. This lightens the work of lecturers or teachers on campus and schools. In addition, the detection system can also improve classroom security from students who are not applied. Based on the description above, this research is focused on developing the title "Student number detection system using the Internet-based image classification method INTERNET OF THINGS (IoT)". This system is designed using a laptop device to process and manage student data, and a camera module as a face detection device. The counting results are recorded in the student database and displayed on the student number website page. The results

of this study are expected to simplify the process of detecting the number of students.

In recent years, the Internet of Things (IoT) has gained increasing attention in both academia and industry. IoT is a concept that describes a vision in which everyday objects will be connected to the internet, identified, and, potentially, communicate with other devices.

The Internet of Things is a term that has emerged to refer to the access of electronic devices via the internet. This device access occurs through human connections using the internet. This device access arises from the desire to share data, share access, and also consider security.

## Understanding the system

The system according to the meaning of the word is a unity or collection of elements or components or subsystems that interact with each other to achieve certain goals. Where each element or component has its own function and way of working but remains in a single function or work unit. The function and interaction of each component element will not clash or contradict each other, because they are all interdependent and need each other to achieve certain goals. The opinion in the book on information system processing (Oemar Hamalik, 1993), defines a system as a whole or totality consisting of parts or sub-systems or components that interact with each other and

with the whole to achieve predetermined goals. O'Brien (2005) A system is a group of interconnected components, working together towards a common goal by receiving input and producing output through an organized transformation process.

According to the book on management information systems (Onong Uchjana Effendy, 1989), a system model is composed of input, process, and output. This means that a system can have multiple inputs and outputs. Input is a component through which the system operates, while output is the result of the operation. In simple terms, output means the goal, objective, or target of a system's operation. Jogiyanto Hartono (2005) defines a system as a network of interconnected procedures, gathered together to perform activities or accomplish specific goals.

Meanwhile, a process is an activity that can transfer input into an output. Thus, it is clear that a system or subsystem can consist of several processes that convert input into output, and these processes are called system parameters, which are the elements that form the system. From the opinion above, the researcher concludes that a system is a collection of elements, parts, subsystems, or components that are interrelated with each other to support the achievement of a goal.

## System definition

Based on these requirements, a system can be defined as a set of elements combined with each other for a common purpose. A collection of elements consists of humans, machines, procedures, documents, data or other elements organized from these elements. System elements are not only related to each other, but also relate to their environment to achieve predetermined goals. There are several definitions of a system, namely: - Gordon B. Davis (1984) "A system consists of interrelated parts that operate together to achieve some goals or purposes." - Raymond Mcleod (2001) "

A system is a collection of interrelated elements that form a complete and integrated whole. The following is the definition of a system according to experts: The term system is a term from the Greek "system" which means

a collection of parts or elements that are interconnected in an orderly manner to achieve a common goal. Definition of a system according to a number of experts: 1. L. James Havery

According to him, a system is a logical and rational procedure for designing a series of components that are related to each other with the intention of functioning as a whole in an effort to achieve a predetermined goal. John Mc Manama, a system is a conceptual structure composed of interrelated functions that work as an organic unit to achieve a desired result effectively and efficiently. 3. C.W. Churchman.

According to him, a system is a set of parts that are coordinated to carry out a set of goals. 4. J.C. Hinggins, according to him, a system is a set of interconnected parts. Edgar F Huse and James L. Bowdict According to him, a system is a series or series of parts that are interconnected and dependent in such a way that the interaction and mutual influence of one part will affect the whole.

## Definition and purpose of detection

Detection is a process of examining or conducting an examination of something using certain methods and techniques. Gollmann (2011) System detection is a security function that acts as a "layer of defense" to find errors, misuse, or attacks that cannot be prevented by other security mechanisms. Mishra (2011) System detection is the system's ability to recognize normal activity patterns and detect deviations (anomalies) from those patterns.

Detection can be used for a variety of problems, such as in an object detection system, where the system identifies disease-related problems, commonly referred to as symptoms. The goal of detection is to solve a problem in various ways, depending on the method used, to produce a solution.

## Definition of student

A student is a student who is registered and studying at a tertiary institution (Diponegoro University Guidelines 2004/2005, p. 94) A student is categorized as being in the developmental stage between the ages of 18 and 25. This stage can be classified as late adolescence to early adulthood and from a developmental perspective, the developmental

task at this student age is to establish one's life stance (Yusuf, 2012).

Based on the description above, it can be concluded that a student is a learner aged 18 to 25 years who is registered and undergoing his education at a tertiary institution, whether from an academic institution, polytechnic, college, institute, or university. Meanwhile, in this study, the subjects used were two students aged 23 years and still registered as active students. Students can be defined as individuals who are currently studying at a tertiary institution, whether public or private, or other institutions at the same level as a tertiary institution (Siswoyo, 2007).

According to the Indonesian Language Dictionary (KBBI), students are those who are studying at a university. A student is a status held by someone because of their relationship with the university who is expected to be an intellectual candidate or it can also be defined as a person who studies or studies at a university, be it at a university, institute or academy.

According to the Great Dictionary of the Indonesian Language (2008), the definition of a student is a person studying at a university. After completing their education at school, some students are unemployed, looking for work, or continuing their education at a university level. Those registered as students at a university can be referred to as students (Takwin, 2008). A student is someone who is in the process of gaining knowledge or studying and is registered to be studying at one of the forms of higher education consisting of academies, polytechnics, colleges, institutes, and universities (Hartaji, 2012).

## Definition of student

Students can be defined as individuals who are studying at a university, whether public or private, or other institutions at the same level as universities. Students are considered to have a high level of intellectual ability, intelligence in thinking, and planning in acting. Scarfone & Mell (2007) System detection is a mechanism for recognizing unauthorized, dangerous, or deviant activity in security policies on a system or network.

Critical thinking and acting quickly and accurately are traits that tend to be inherent in every student, which are complementary principles (Siswoyo, 2007). Studying in college is very different from studying in school (Furchan, 2009), students play more of a role as recipients of knowledge while teachers function as facilitators who help students achieve agreed-upon learning goals.

## Image Classification Method

Image classification is a process designed to classify images according to specific categories. In image classification tasks, the mapping of features from an image to a class label is represented by a feature vector or image pixels. Image classification plays a crucial role in computer vision and its applications, such as motion categorization and image retrieval (Fang et al., 2019). Convolutional neural network-based methods have demonstrated excellent performance in image classification, which aims to identify features from training images.

### *Internet Of Things (IOT)*

IoT (Internet of Things) can be defined as the ability of various devices to connect to each other and exchange data over the internet. IoT is a technology that enables control, communication, and collaboration with various hardware devices and data over the internet. Therefore, it can be said that the Internet of Things (IoT) is when we connect things that are not operated by humans to the internet.

However, IoT is not only related to remote device control, but also how to share data, virtualize everything real into the internet, and so on. The internet becomes a connection between machines automatically. In addition, there are also users who serve as direct managers and supervisors of the operation of these devices. The benefit of using IoT technology is that work done by humans becomes faster, easier, and more efficient. (Maiti & Bidinger, 1981)

The concept of connected devices dates back to 1832, when the first electromagnetic telegraph was designed. The telegraph enabled direct communication between two machines through the transfer of electrical signals. However, the true history of the IoT begins with

the invention of the internet (a crucial component) in the late 1960s, which then rapidly expanded over the following decades. The idea of adding sensors and intelligence to basic objects was also discussed throughout the 1980s and 1990s (and arguably even earlier), but progress was slow due to the immaturity of the technology.

At that time, chips were too large and bulky, and there was no way for objects to communicate effectively. One of the first truly recognizable examples of IoT was invented in the early 1980s at Carnegie Mellon University.

The Internet of Things works by utilizing a programming argument, where each command generates an interaction between machines that are automatically connected without human intervention and at any distance. The internet serves as the link between these interacting machines, while humans only act as direct controllers and supervisors of the devices' operation.

## Research method

This research aims to produce a system that can provide classroom security, design and understand a student facial recognition system in the classroom, and develop a system for detecting the number of students. Students using the IoT-based image classification method can make it easier for lecturers or teachers to document the number of students. This study uses a campus or school room as the case study location.

In this research, the method used is a quantitative method. The quantitative method is data in the form of numbers or qualitative data that is quantified (Sugiyono, in Asnawi: 2009:43).

## Location and time of research

In carrying out research, researchers do this by:
1. Research location

In writing a thesis entitled "Student Number Detection System Using the Internet-Based Image Classification Method INTERNET OF THINGS (IoT), the author conducted research in a campus room.
2. Research time

The research was conducted for approximately 2 months.

B. Needs Analysis

The requirements for designing a system are grouped into two parts, namely hardware and software:
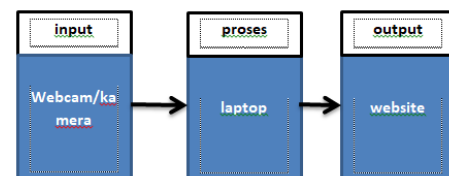
a. Hardware
• Laptop
b. Software
• Raspios-buster-armhf-full.zip.torrent
• Visual studio code(VSCode Microsoft)

## Block diagram

The components for creating a system for calculating the number of students is grouped into several parts as input, process and output as can be seen in the block diagram below.



The block diagram explanation is as follows:
- Input
  The component for input into the system is the webcam device in the student counting system.
- Process
  In the process section, there is a laptop device that functions to process data input from the webcam so that it is saved to the system database.
- Output
  The output of the system calculates the number of students to display the results of the calculation in real time.

## System creation
1. Data collection and literature study
   In designing this system, several procedures were implemented to complete the design. The stages are as follows:
   a. The data collection in question is a review carried out directly on the object being studied, by conducting direct observations on how to count the number of students using the classification method.
   b. The literature study in question is the collection of data regarding designs made by reading and tracing literature in books, theses related to design and from information media such as e-books, online journals and others.

2. System planning

After determining the specifications required by the system, the next stage is to design the system.

3. Software development

The software development included laptop software, interface software (web interface), and a Python program called OpenCV for face detection. The website was created using PHP, and the face detection process was performed using OpenCV Python.

**DISCUSSION**

The system for calculating the number of students using the Internet-based image classification method INTERNET OF THINGS (IoT) has been designed as carefully as possible. After going through several stages of research including the design of the system to be created, the creation of the system topology and the creation of software, the previously desired goal has been achieved, namely the system for calculating the number of students using the Internet-based image classification method INTERNET OF THINGS (IoT). The following are the details of the system that has been created:

The system is divided into 4 main components, namely the first is the camera system device component, a laptop device as a place to run the detection feature and a data provider that is scanned by the camera.

**How the system works**

After carrying out the stage of creating a system for calculating the number of students, several stages of testing will be carried out, some of the tests on the system are as follows:

**System test results**

The image shows the display of student data or student identity calculated on the web server.
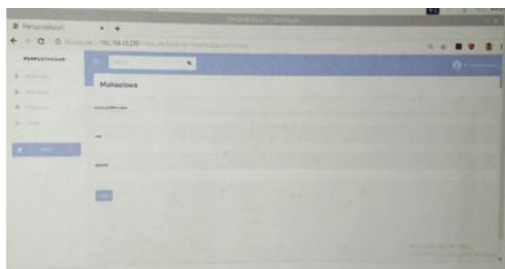


**Student dataset collection**



The image above is a menu for the process of taking student datasets for processing so that the system can detect students according to their name and student ID number.

**Student data training**



The image above is a menu display for training student data after the dataset collection process so that the system will easily detect and count students.

**Student Detection System Test Results**

Student detection system test table

From the system test results table below, it has been tested 15 times with a total of 15 students' test data. Of the 15-test data, 13 data were successfully detected and 2 data failed to be detected. The failure to detect 2 data was caused by being far from the range of the device's camera system and being affected by lighting so that the device's camera could not detect it.

In this research, a fuzzy logic algorithm was used to evaluate the results of the tool testing and the quality of the detection of 15 test data that had been obtained. Fuzzy logic was used to classify the results into Success, less detection, Failure to facilitate decision making and evaluation of the tool's performance.

| No | Nama Mahasiswa | Waktu Dibutuhkan | Jarakdeteksi | Keterangan |
|----|------|------|------|------|
| 1 | Mahasiswa 1 | 4 detik | 20 cm | Berhasil mendeteksi dan hitung |
| 2 | Mahasiswa 2 | 5 detik | 30 cm | Berhasil mendeteksi dan hitung |
| 3 | Mahasiswa 3 | 3 detik | 50 cm | Berhasil mendeteksi dan hitung |
| 4 | Mahasiswa 4 | 3 detik | 60 cm | Berhasil mendeteksi dan hitung |
| 5 | Mahasiswa 5 | 4 detik | 70 cm | Berhasil mendeteksi dan hitung |
| 6 | Mahasiswa 6 | 3 detik | 80 cm | Berhasil mendeteksi dan hitung |
| 7 | Mahasiswa 7 | 4 detik | 90 cm | Berhasil mendeteksi dan hitung |
| 8 | Mahasiswa 8 | 5 detik | 100 cm | Berhasil mendeteksi dan hitung |
| 9 | Mahasiswa 9 | 5 detik | 115 cm | Berhasil mendeteksi dan hitung |
| 10 | Mahasiswa 10 | 5 detik | 130 cm | Berhasil mendeteksi dan hitung |
| 11 | Mahasiswa 11 | 4 detik | 150 cm | Berhasil mendeteksi dan hitung |
| 12 | Mahasiswa 12 | 4 detik | 160 cm | Berhasil mendeteksi dan hitung |
| 13 | Mahasiswa 13 | 5 detik | 170 cm | Berhasil mendeteksi dan hitung |
| 14 | Mahasiswa 14 | 5 detik | 180 | gagal mendeteksi dan hitung |
| 15 | Mahasiswa 15 | 5 detik | 190 | gagal mendeteksi dan hitung |

## CLOSURE

From the results of the research and discussion on the creation of a student number detection system using the Internet of Things (IoT)-based image classification method, the following conclusions can be drawn:

1. In the creation of a student number detection system using the Internet-based image classification method, INTERNET OF THINGS (IoT) has worked well in detecting and counting the number of students in the room, for data from the camera that enters the laptop to be managed, then the data from the laptop is processed into a database and displayed on the web dashboard page.
2. In detecting the number of students in the room, this study used a website to display student data in real time.

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