

INTERNET OF THINGS BASED BIRD CHIRPING TRAINER

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ABSTRAK

The Long-tailed cendet is a species of bird known as the Grey-rumped Shama, Pentet, or Toet. The Long-tailed cendet belongs to the Laniidae family and has the scientific name *Lanius schach*. One of the main attractions of this bird is its ability to sing melodiously and imitate the calls of other birds, animals, and sounds around it. One problem faced in keeping Cendet birds is that they often suddenly stop singing. This is due to a lack of mastery of the master's voice, making it difficult for the Cendet to change pitch. The method in this research is to collect and analyze theoretical studies and design hardware and software. To address this issue, a tool was developed to train long-tailed cendet to sing. This research used a Raspberry Pi as the controller, a microphone to record the birds' sounds, which were then sent to the web to monitor their progress, and a camera to synthesize the information. From the test results, this system can work according to the design, namely to train the sound of the long-tailed shrike, successfully record the sound of the long-tailed shrike and remotely monitor the development of the long-tailed shrike.

Kata kunci : *Raspberry pi, Camera, microphone, speaker*

1. INTRODUCTION

Birds are easily found around human habitation, including urban areas. Bird species diversity can be an indicator of environmental health in an area. Urban birds have a high tolerance for human presence. The abundance of bird species in cities, combined with the diverse habitat conditions, makes bird communities suitable as indicators of urban ecosystems [1].

The long-tailed cendet, also known as bentet, pentet, and toet (West Java), is an aggressive perching and predatory bird from the Laniidae family. The Laniidae family includes 74 species divided into four subfamilies. The common long-tailed cendet belongs to the subfamily Laniinae and the genus *Lanius*.

Along with the black-and-white long-tailed shrike (*L. ludovicianus*), these birds are common species in the New World (America). Another species, the lesser gray long-tailed shrike (*L. minor*), is found in southern Europe, Central Asia, and eastern Africa.

Some long-tailed cendet occasionally stop singing. This is due to a lack of practice by their owners, which makes it difficult for them to change tones. When the song ends, the long-tailed shrikes will pause for a moment before resuming their singing with a new tune.

To address this issue, long-tailed cendet are trained to produce a wide variety of chirps. To facilitate this training, a device for remote training is needed, eliminating the need for owners to approach their cages.

2. LITERATURE REVIEW

2.1. Python Programming Language

Python is an interpretive programming language considered easy to learn and focuses on code readability. Python generally embraces object-oriented, imperative, and functional programming. Python's features and advantages include: 1. A large library collection, with ready-to-use modules for various needs; 2. A clear, simple, and easy-to-learn language structure; 3. Object-oriented; 4. An automatic memory management system; and 5. Modular [2].

The Python Software Foundation (PSF) is a non-profit organization that officially owns the intellectual property rights to Python since version 2.1. This organization is responsible for supporting the development, distribution, and use of Python globally. Python has become one of the fastest-growing programming languages in the world. One of the main reasons for this popularity is its widespread use in data science. Python offers a variety of libraries such as NumPy, Pandas, and Scikit-learn that facilitate data analysis, machine learning, and scientific computing. This makes Python a top choice for data professionals and researchers, further fueling the growth of its community [3].

2.2. Raspberry Pi Model B+

The Raspberry Pi is a minicomputer developed by the Raspberry Pi Foundation in the UK. By using a Raspberry Pi as a web server and connecting it to a network, it is possible to create a remote control system within the same network [4].

The Raspberry Pi 3 Model B+ is the third generation of the Raspberry Pi. This third generation has two models: B and B+. The Raspberry Pi 3 Model B+ uses a 64-bit Broadcom BC2837 ARM-8 Quadcore Processor with Cortex-A53 graphics integrity [5].

The Raspberry Pi enhances the performance of the Model B+ by using a new 1.4GHz Broadcom BCM2873B0 Cortex A53 64-bit chipset. This chipset offers improved temperature management, allowing it to run at full speed for longer before throttling due to heat [6].

2.3. PHP: Hypertext Preprocessor

PHP, or Hypertext Preprocessor, is a server-side programming language, also known as a programming language that is executed from the server's perspective. PHP's primary use in website development is to process data in a database. Website data is entered into the database, modified, deleted, and displayed on the website, as configured by PHP [7].

One of PHP's key strengths is its ability to integrate efficiently with a wide variety of databases, including MySQL. This makes PHP a popular and flexible choice for developing data-driven web applications [8].

MySQL is a database server program capable of receiving and sending data quickly using SQL commands. MySQL has two forms of license, namely Freeware and Freeware. MySQL Freeware is under the GNU/GPL (General Public License). In addition to being a free and open source database program, there is also a commercial MySQL, namely MySQL AB. In MySQL, there are 3 sublanguages, namely Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL). DDL is used to build objects in the database, such as tables and indexes. DML is used to add, search, modify, and delete rows in the table. While DCL is used to handle security issues in the database [9].

Mysql is very good to use because it can handle security layers, such as host names, access permissions in accessing subnet mask levels, passwords, and most importantly it is free [10].

The Apache web server, commonly known as the Apache HTTP Server, is maintained and developed by the Apache Software Foundation. The project was first introduced in 1995 and has become the most widely used web server worldwide. Apache is a popular and widely used open-source web server platform worldwide. Below are some of the functions, advantages, and disadvantages of the Apache web server [11].

The Apache web server's functions include enabling access permissions and authentication, speeding up website load times with caching and proper configuration settings, and integrating with

the latest technologies such as PHP, MySQL, and Perl [12].

2.4. Speaker

A speaker, also known as a loudspeaker, is a device that converts electrical signals into audio frequencies (sound) by vibrating a membrane-shaped component to vibrate the air so that sound waves are produced that reach the eardrum and can be heard as sound [13].

3. RESEARCH METODOLOGY

This design is divided into two parts: hardware design and software design. Each of these parts will be structured to produce a device with functions consistent with the initial plan.

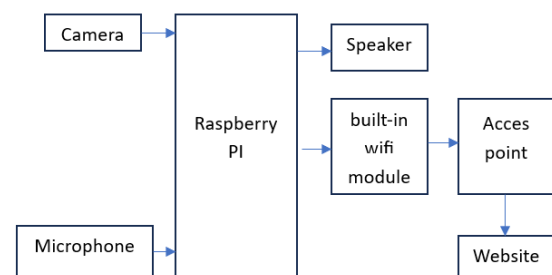


Figure 1. System Block Diagram

The microphone is used to store bird call recordings, while the Raspberry Pi Cam is used for live streaming. The bird call recordings are input to a Raspberry Pi. The Raspberry Pi serves as the programming platform for sound detection and voice training. The Raspberry Pi is used as a live streaming camera. The Raspberry Pi then inputs the audio to a speaker, which emits sounds for the birds to hear. An internal Wi-Fi module is used to receive and send data. An access point is used for internet communication. The web is used to control the bird call training.

3.1. Raspberry Pi Cam Design

This design uses the Raspberry Pi Cam module to carry out monitoring

Table 1. Raspberry Pi Cam Pin Configuration

Camera	Raspberry Pi
Cabel Flat	CSI Camera Port

3.2. Speaker Design

In this design, speakers are used to provide sound to the birds.

Table 2. Speaker Pin Configuration

Speaker	Sound Card
Audio Jack Speaker	Speaker Jack Audio Port

3.3. Microphone Design

In this design, a microphone is used to record bird sounds.

Table 3. Microphone Pin Configuration

Microphone	Sound Card
Mic Jack Audio	Audio Jack Mic Port

3.4. External Sound Card

This type of sound card is the latest model and is currently in high demand. Besides producing high-quality sound, installation is simply plug and play. This external sound card is suitable for recording audio directly from the Raspberry Pi's USB port.

Table 4. External Sound Card Pin Configuration

External Sound Card	Raspberry Pi
USB	USB ports

3.5. Software System Design

In the image below, performing `sudo apt get – update` on the raspberry pi is for updates designed to fix problems by updating a raspberry pi program or adding supporting data, including fixing vulnerabilities and improving usability and performance.

```
pi@raspberrypi ~$ sudo apt-get update
Hit http://mirrordirector.raspbian.org wheezy InRelease
Hit http://archive.raspbian.org wheezy InRelease
Hit http://archive.raspbian.org wheezy/main armhf Packages
Ign http://archive.raspbian.org wheezy/main Translation-en_GB
Ign http://archive.raspbian.org wheezy/main Translation-en
Get:1 http://mirrordirector.raspbian.org wheezy/main armhf Packages [7,414 kB]
Get:2 http://mirrordirector.raspbian.org wheezy/contrib armhf Packages [23.2 kB]
Get:3 http://mirrordirector.raspbian.org wheezy/non-free armhf Packages [48.0 kB]
Get:4 http://mirrordirector.raspbian.org wheezy/rpi armhf Packages [569 B]
Ign http://mirrordirector.raspbian.org wheezy/contrib Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/main Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/main Translation-en
Ign http://mirrordirector.raspbian.org wheezy/non-free Translation-en_GB
Ign http://mirrordirector.raspbian.org wheezy/rpi Translation-en_GB
Fetched 4 B in 1min 51s (0 B/s)
Reading package lists... Done
pi@raspberrypi ~$
```

Figure 2. Raspberry Pi Os Update

In this image `sudo apt get upgrade` on raspberry pi to install the latest versions of all packages currently installed on the system from the sources mentioned in `/etc/apt/sources.list`.

```
pi@raspberrypi ~$ sudo apt dist-upgrade
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
The following packages were automatically installed and are no longer required:
  gsfonstools gsfonstools-x11 libmotif-common libxkbcommon libxkbcommon-x11
  python-gobject python-gobject-2 python-gtk2 python-xlib
Use 'sudo apt autoremove' to remove them.
The following packages will be REMOVED:
  nodejs-legacy
The following NEW packages will be installed:
  libx-ares2 libx-ares2-doc nodejs-doc
The following packages will be upgraded:
  ca-certificates dosbox dpgk dpgk-dev file libdpkg-perl libfaad2 libgpg
  libgpg-common libmagick-magick libmagick1 libpam-systemd libsystemd0 libudev1
  nodejs nodered patch shared-mime-info systemd systemd-sysv tzdata udev
  xorgxrdp xrdp
24 upgraded, 3 newly installed, 1 to remove and 0 not upgraded.
Need to get 28.9 MB of archives.
After this operation, 8,822 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
```

Figure 3. Raspberry Pi Os Upgrade

In Figure 4, install the VCL media player on the Raspberry Pi desktop to play the song that will be played when training the duration of bird chirping. The VCL media player is also used to play the results of the recording that has been done previously. The VCL media player can be played on the Raspberry Pi desktop.

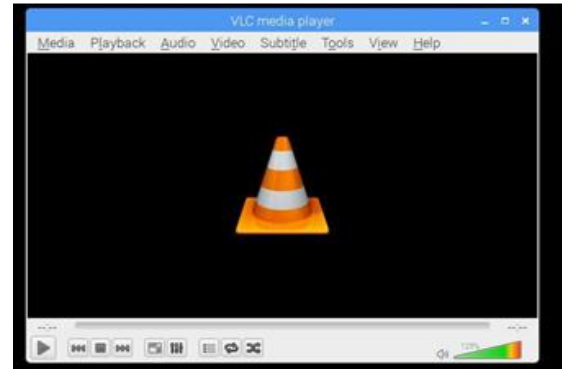


Figure 4. Install VCL Media Player on Raspberry Pi Desktop

Before starting to configure Raspberry, you must activate the Raspicam CSI port and expand the root file system, which is done only once at the start of programming, after which it will automatically activate itself.

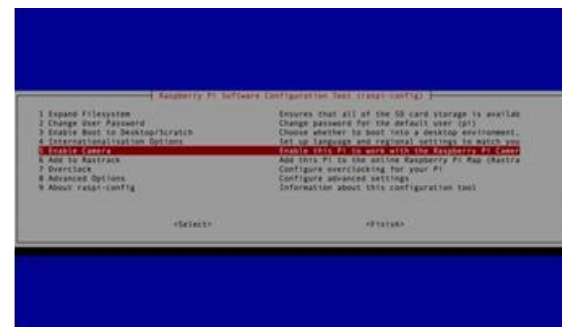


Figure 5. Activate Camera

In Image 6, to live stream on a Raspberry Pi, first enter the address provided in the image below, then enter the address provided on the website. Once you've done all of this, you can live stream on your Raspberry Pi.

```
ngrok by @inconshreveable
Session Status      online
Session Expires    7 hours, 51 minutes
Version            2.3.30
Region             United States (us)
Web Interface       http://127.0.0.1:4040
Forwarding          http://0bfe823c.ngrok.io -> http://localhost:80
                   https://0bfe823c.ngrok.io -> http://localhost:80

Connections
  ttl    opn    rt1    rt5    p50    p90
    3     0     0.00   0.00   4.96   5.01

HTTP Requests
-----
GET /favicon.ico           404 Not Found
GET /icons/openlogo-75.png 200 OK
GET /                      200 OK
```

Figure 6. Program for Running Live Streaming Click (<http://0bfe823c.ngrok.io>)

3.6. Tool Flowchart

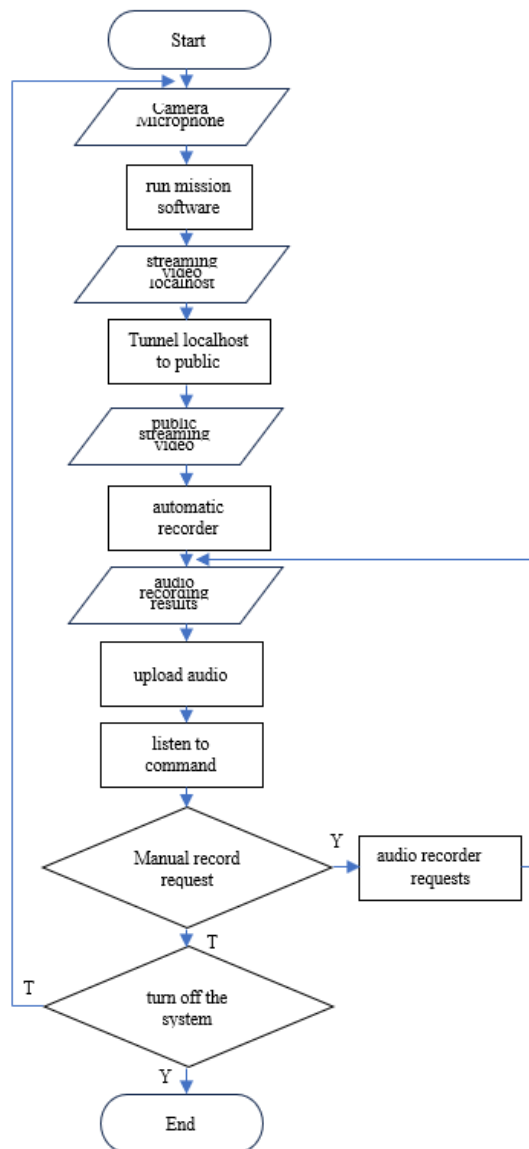


Figure 7. Tool Flowchart

4. RESULTS AND DISCUSSION

The tests to be performed will involve testing each circuit block individually. Once all circuit blocks have been tested and are functioning properly, the next step is testing the entire system.

4.1. Interface Display Implementation



Figure 8. Login Page Display



Figure 9. Video Monitor Page View

4.2. Speaker Testing

To get the results of the speaker test, search for the file that will be uploaded to the web. After uploading, you can immediately run the audio on the web.

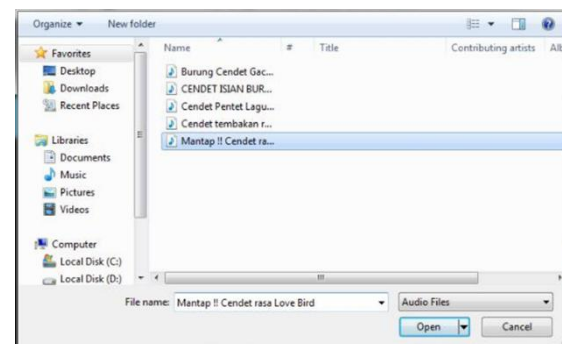


Figure 10. Audio File Upload Page View

4.3. Raspberry Pi Cam Testing

Testing on the Raspberry Pi Cam to find out whether it can work well according to the commands from the Raspberry Pi, the Raspberry Pi Cam is used for live streaming to see the condition of the birds every day.

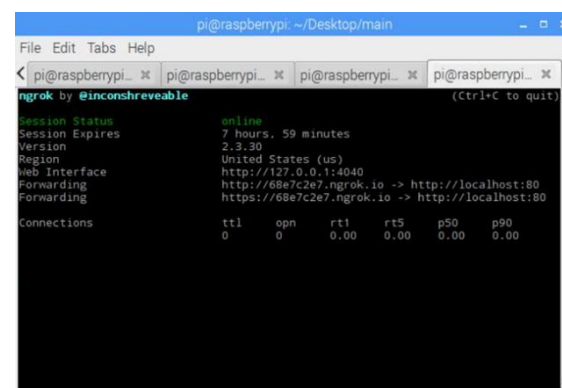


Figure 11. Camera Program on Raspberry Pi

4.4. Microphone Testing

This test aims to record the sounds of birds that have been trained every day to be able to find out the results of the development of sounds that are controlled via the web.

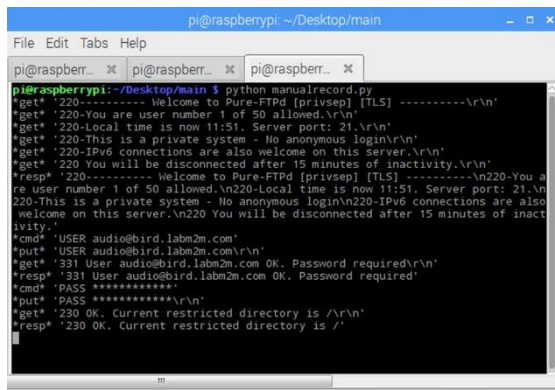


Figure 12. Manual Voice Recording Program on Raspberry Pi

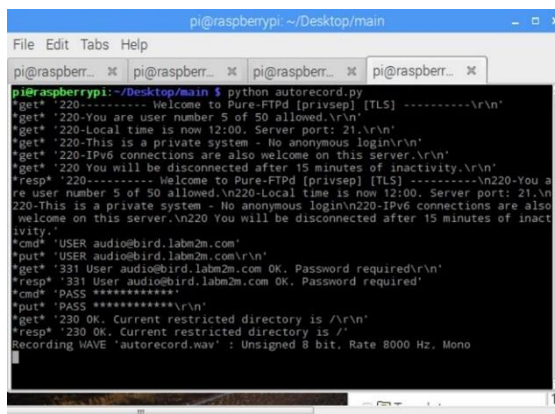


Figure 13. Automatic Voice Recording Program on Raspberry Pi

4.5. Whole System Testing

This overall system testing is carried out to determine the performance of the tool according to the system design starting from block by block between hardware and software.

4.6. Live Streaming Testing

This tool can do live streaming every day on to find out the condition of the birds.



Figure 14. Camera Testing

4.7. Speaker Testing

This tool will train the bird's voice every day when it is time to do voice training.

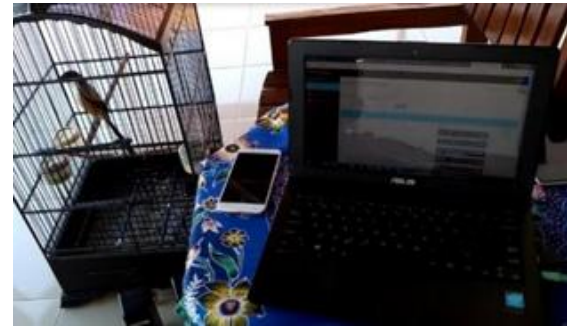


Figure 15. Speaker Testing

This tool can record both manually and automatically. Automatic recording is timed every 1 minute. Manual recording can be done daily.

Table 5. Assessment Results of Bird Sound Training Duration for 1 Month

	White	Yellow	Blue	Red White	Poin
Week to 1	2	3	1	0	90
Week to 2	5	1	2	1	215
Week to 3	2	6	1	3	420
Week to 4	1	2	2	4	525

This experiment was conducted over a month, with weekly observations to determine the duration of the song. Every chirp of a predetermined duration earned one flag. Two chirps earned two flags of a predetermined duration and points, and so on for the remaining flags. The number of flags produced was then added up to determine the number of points earned by the chirps in the hanging cage. For example, in week 1, two white flags were obtained, each worth 5 points. Two white flags earned 10 points. The same applies to the other flags. So, in the first week, two white flags = 10 points + three yellow flags = 30 points + one blue flag = 50 points. The total number of flags produced by the long-tailed shrike in the hanging cage was 90 points.

5. CONCLUSION

After designing and testing, the camera can be used for live streaming. During the vocal training process, the birds were able to imitate the sounds produced. During the vocal recording test, the birds were able to imitate the output they had been trained to produce daily. The entire system test concluded that all the device's experiments were successful.

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