Designing and Building Onboard Capture Screen Cattle Artificial Insemination Device

Sugiyanto[1], Handoko[1*], Nurulia Hidayah[2]

[1]Department of Mechanical Engineering, Vocational College, Universitas Gadjah Mada, Indonesia

[2]Department of Bioresources Technology and Veterinary, Vocational College, Universitas Gadjah Mada

*Corresponding author's email: sugiyanto_t@ugm.ac.id

doi: https://doi.org/10.21467/proceedings.151.47

ABSTRACT

In Indonesia, the decline of the calf birth rate affects the cattle population. One way to increase the population and birth rate of cattle can be done through artificial insemination. However, using artificial insemination devices does not guarantee the accuracy of the cattle's heat period. An artificial insemination device integrated with an endoscopic camera combined with photo, video, and temperature capture methods is needed to carry out the stages before and after the placement of sperm semen on the ovaries, namely the heat period and pregnancy detection. The design of this artificial insemination device, known as the IB-G2, is emphasized so that insemination officers are more focused by positioning the screen on board. The IB-G2 was successfully made with a 1.4 GHz processor specification, 1GB memory, 3.5" 320x480 Dots color touch screen LCD, 640x680p camera, and a temperature sensor range -55 to 125 °C. The IB-G2 is expected to contribute to helping inseminators in particular and farmers in general to catalyze the cattle population increase.

Keywords: Artificial Insemination, Cattle Population, IB-G2, Inseminator.

1 Introduction

Artificial insemination (AI) or *Inseminasi Buatan* (IB) is a reproductive technology that aims to increase the reproductive efficiency of both female and male livestock, spread superior seeds, and prevent the spread of venereal diseases in livestock [1]. The AI program is carried out without directly meeting female and male cattle [2]. Factors that influence the success of AI are the accuracy of heat detection by breeders, the ability of inseminators, semen quality, and female reproductive conditions [3]. The success of AI is not only for ruminants but can also be used for poultry [4].

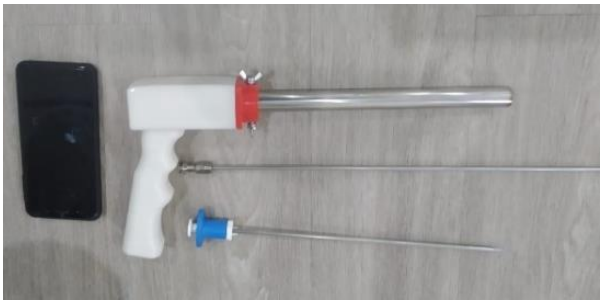

Figure 1: *First generation of IB-Gun.*

Reproductive technology and reproductive management in the form of intensification of natural mating (INKA) and artificial insemination that have been implemented have not been fully successful in boosting the increase in the national cattle population. This condition underlies the Ministry of Agriculture to issue a Special Efforts Program (UPSUS) for Mandatory Pregnant Cows (SIWAB). The UPSUS SIWAB, IB, and INKA activities which have been taking place regularly since a few years ago, have maximized integrated performance, and reproductive management of productive female livestock can be optimized. In addition, some of the UPSUS SIWAB activities are optimizing artificial insemination, providing, and distributing

Proceedings DOI: 10.21467/proceedings.151; Series: AIJR Proceedings; ISSN: 2582-3922; ISBN: 978-81-961472-6-6

frozen semen seeds and AI infrastructure (liquid nitrogen, AI equipment), and increasing the quantity and quality of human resources [5].

Department of Mechanical Engineering, Vocational College, Universitas Gadjah Mada, as an academic institution with human resources, machines, and equipment, has contributed to the success of the UPSUS SIWAB program, especially the manufacture of IB devices. This started with creating the first generation IB-Gun, as shown in Figure 1. This IB-Gun can detect heat and pregnancy in cows to increase the success of IB. The IB-Gun is equipped with a high-resolution camera and sufficient lighting to detect the cervix of female livestock to assist in the placement of the right semen.

This first-generation IB-Gun uses a separate smartphone from the IB-Gun to take pictures and videos. A separate screen from the IB-Gun can obstruct the concentration of officers when looking at the screen and seeing the IB-Gun. This program aims to produce a second-generation IB-Gun (IB-G2) that has an onboard screen to better detect heat, pregnancy, and artificial insemination in cattle. The target of this activity, in general, is to support the UPSUS SIWAB Program, while in particular is to expedite inseminators in Sleman Regency in assisting breeders in obtaining accurate information regarding livestock reproductive health, fertile livestock period and the success of AI in female livestock. The output of this activity is AI equipment that has high accuracy and is safe for livestock.

2 Research Methodology

The manufacture of the second generation of IB-Gun Equipment includes several processes. The first process is to analyze the first-generation IB-Gun, and make improvements to enhance the performance of the second-generation IB-Gun. The first process results are then brought to the Laboratorium of Design, Department of Mechanical Engineering of Vocational College, Universitas Gadjah Mada, to produce the blueprint. The following process is manufacturing parts that are unavailable in the commercial market. The manufacturing of this artificial insemination tool is divided into three critical stages, namely:

- **Manufacture of hand grips**

Making a hand grip on the IB-Gun uses 3D printing technology for a high accuracy and low-weight design. Ergodynamic design is expected to be comfortable to produce high inseminator productivity.

- **Making pipe ends for cameras and IB Gun holes**

The encasement for the camera and the IB-Gun eyelet ensures that the inseminator can work quickly and easily.

- **Equipment assembly**

At this stage, all parts of the equipment consisting of stainless steel pipes, grips, and cameras are assembled and function tested so that they can work properly.

These three stages are schematically presented in Figure 2.

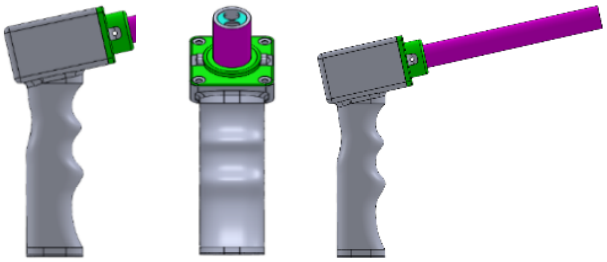

Figure 2: *Stages of the IB-Gun Manufacturing Process*

3 Results and Discussion

The design of the onboard capture screen IB-Gun, as shown in Figure 3, consisting of a pipe, pipe adapter, handgrip, and capture unit on board.

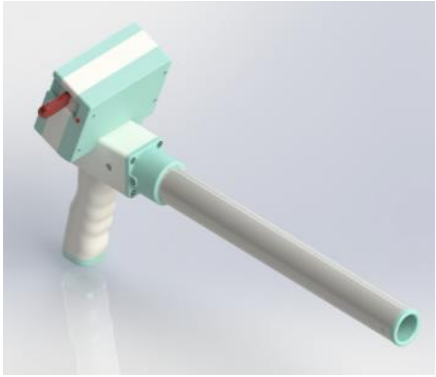

Figure 3: *Design of IB-2 capture unit on board.*

The IB-G2 body printing process uses a flash forge-creator-pro-3d-printer machine, which is done in the Laboratorium of Digital Manufacturing, Department of Mechanical Engineering. One of these processes is shown in Figure 4, and the results of component assembly are shown in Figure 5.

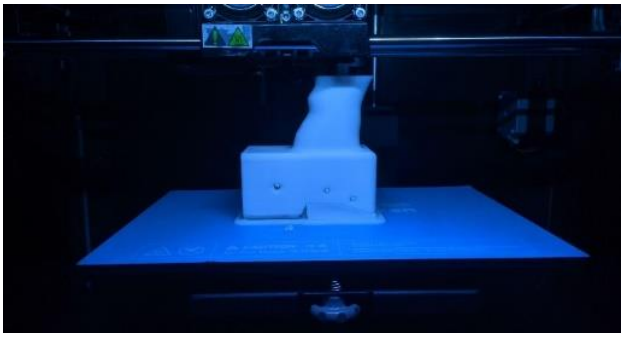

Figure 4: *IB-2 printing process*

Figure 5: *IB-G2 capture type on board*

The software design was carried out to characterize the IB-G2 product and facilitate the IB-G2 inseminator to capture images, videos, and temperature easily. After the hardware and software have been built, the next step is to combine the two into the IB-G2 unit. The results of the combination of hardware and software can be seen in Figure 6, while the IB-G2 technical specifications can be seen in Table 1.

Proceedings DOI: 10.21467/proceedings.151
ISBN: 978-81-961472-6-6

Series: AIJR Proceedings
ISSN: 2582-3922

a. Back

b. Front

c. Image and video capture results

d. Temperature check results

Figure 6: *Merging between hardware and software.*

Table 1: *The specification of IB-G2.*

Type	**Specification**
CPU	1. Processor 1.4GHz 2. Memory 1GB LPDDR2 3. 40-pin GPIO header 4. 4 USB 2.0 ports 5. Micro SD port for loading 6. 5V/2.5A DC power input
SD Card	16GB, 98MB/s Transfer speed
Capacitive Touch LCD	3,5 Inch, 320x480 Dots, 12c GPIO connector
Battery HAT	Support discharge at 2,5A 5Volt DC
Flash Drive	USB
Endoscope Camera	USB Socket, With Light, 640x680p
Temperature Sensor	DS18B, Measurement Range -55 to 125 °C
Micro B USB	2,5 Amp Support charging

4 Conclusions

Each IB-G2 Tool with an onboard capture screen has been completed to improve the previous generation of IB-Gun. The improvement is adding a screen capable of detecting and monitoring temperature, images, and video in one part of the unit. The specifications for the IB-G2 include a 1.4 GHz processor, 1GB memory, 3.5" 320x480 Dots color touch LCD, 640x680p camera, and a temperature sensor ranging from -55 to 125 °C.

5 Declarations

5.1 Acknowledgments

We would like to thank the Directorate of Community Services Universitas Gadjah Mada for funding the realization of the IB-G2 design through the Grant for Utilization of Research Results and Application of Appropriate Technology in 2022.

5.2 Publisher's Note

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How to Cite

Sugiyanto *et al.* (2023). Designing and Building Onboard Capture Screen Cattle Artificial Insemination Device. *AIJR Proceedings*, 344-348. https://doi.org/10.21467/proceedings.151.47

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