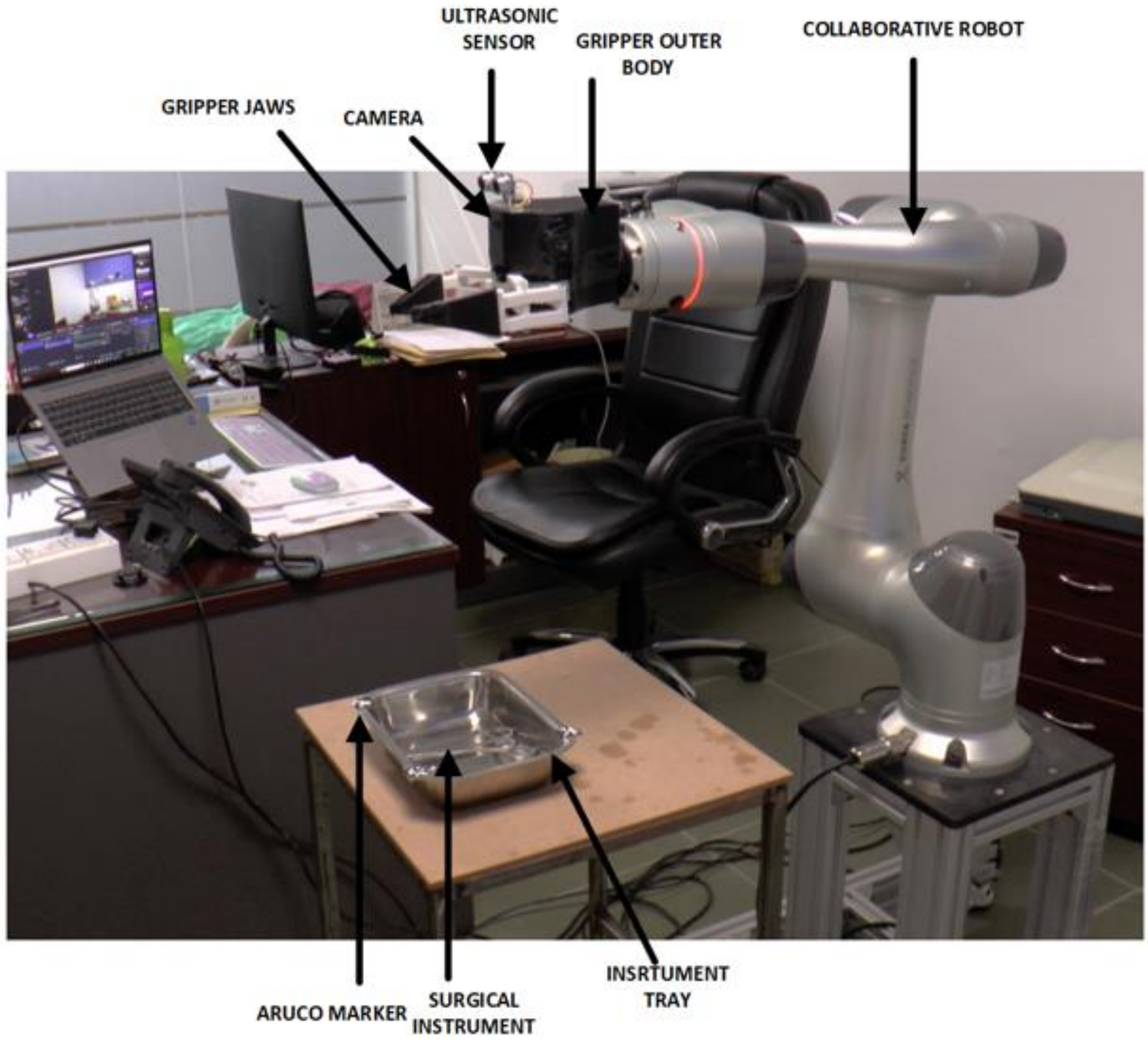


**Fig. 1**

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**Fig. 2**


**Fig. 3**

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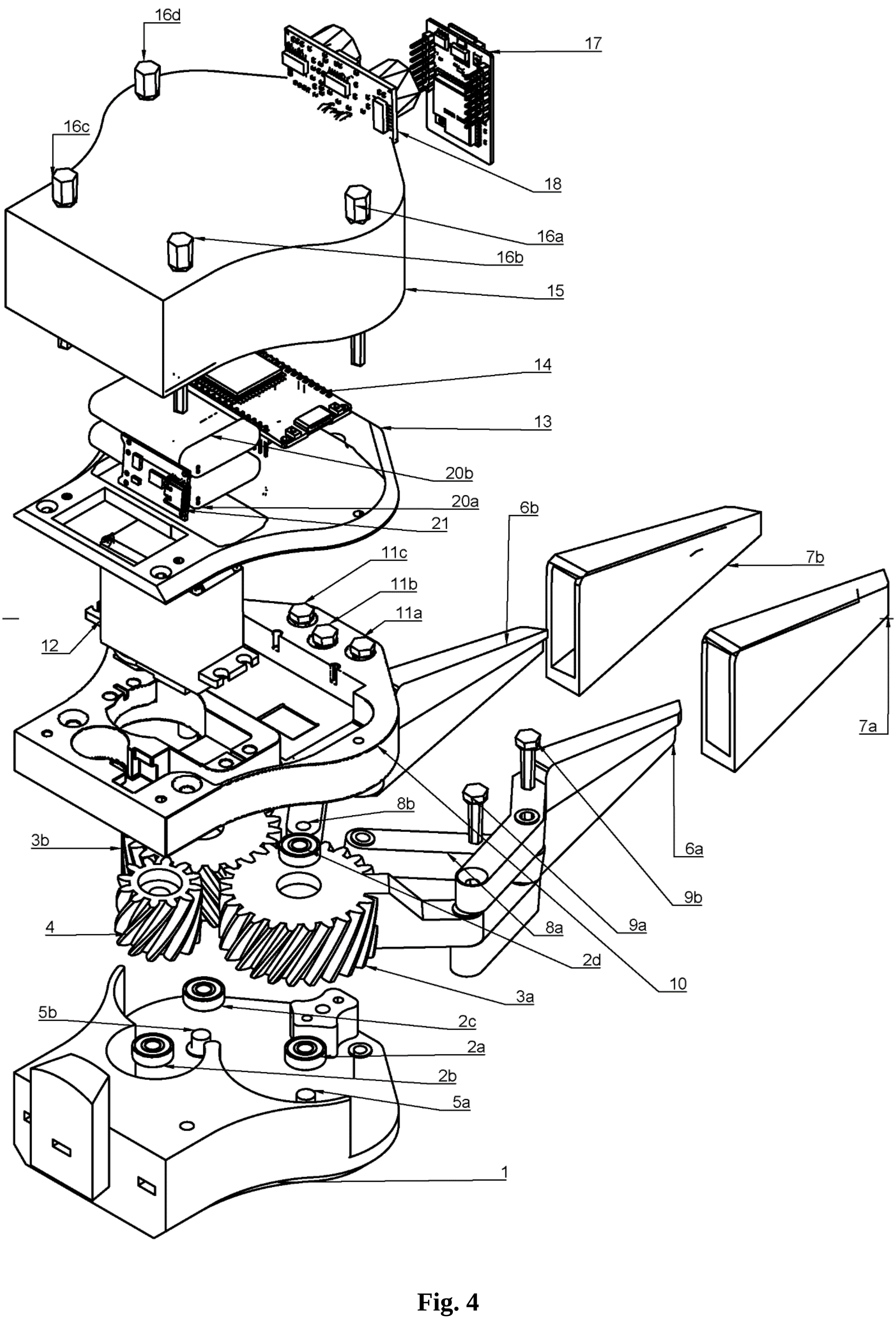


**Fig. 4**

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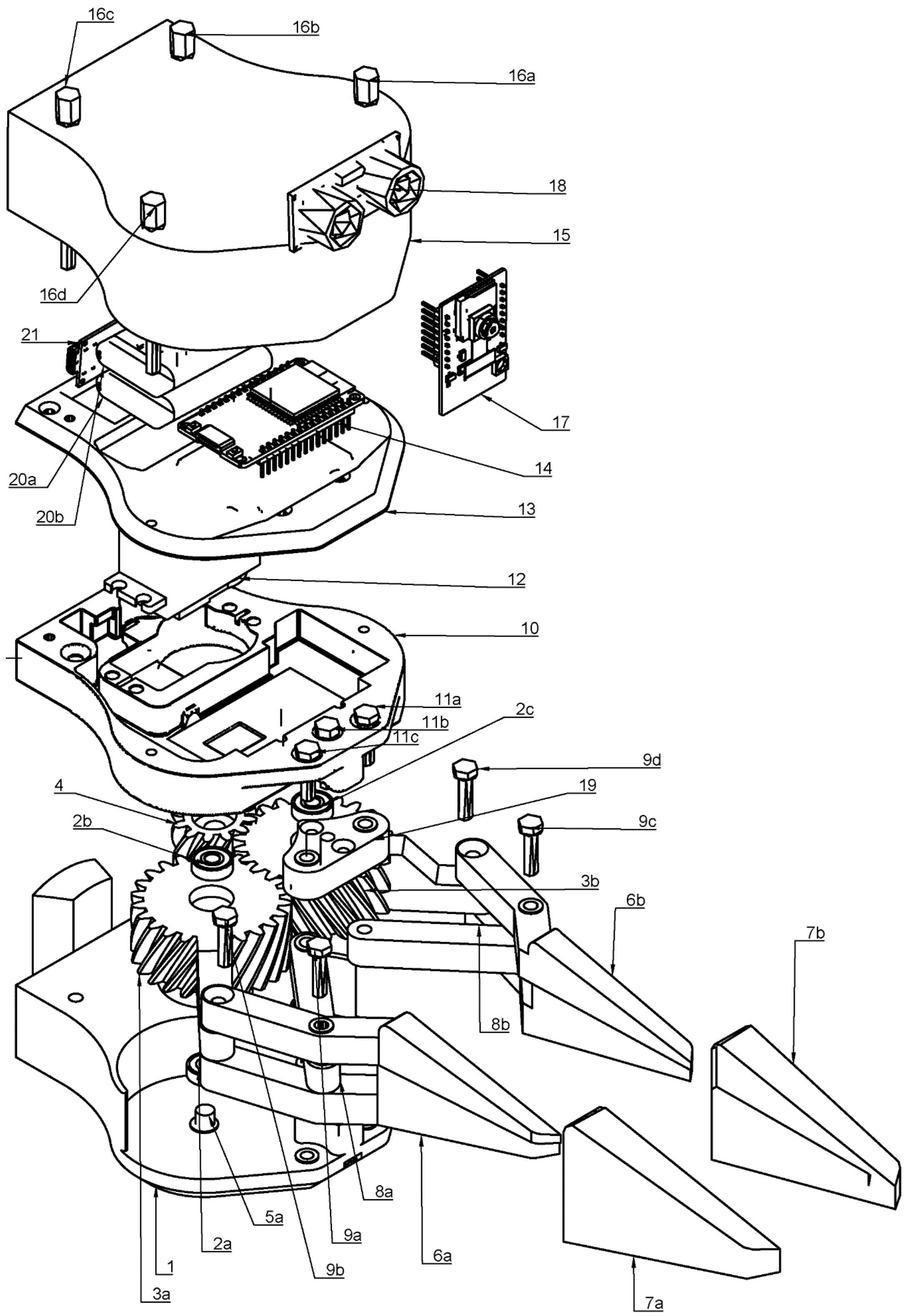


**Fig. 5**

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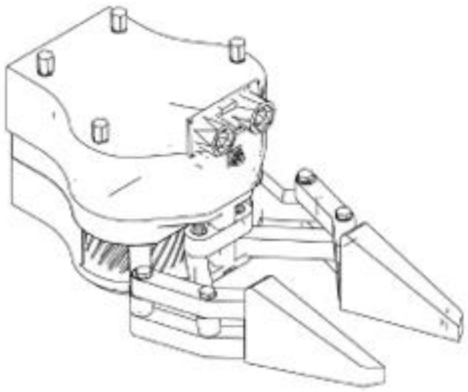
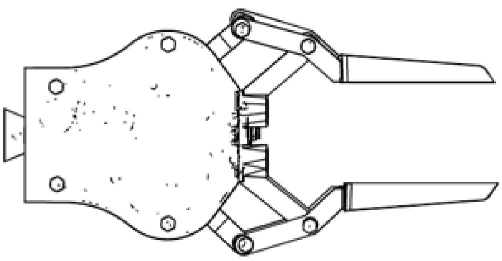


**Fig. 6**



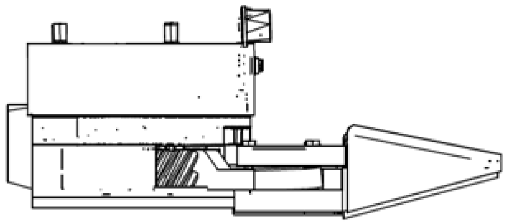


**Fig. 7**

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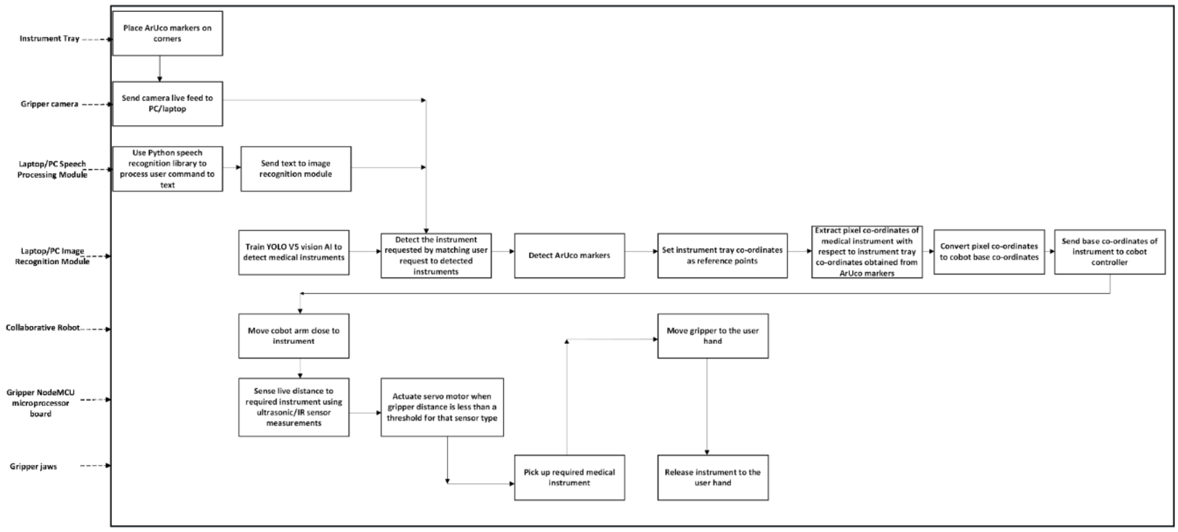


**Fig. 8**

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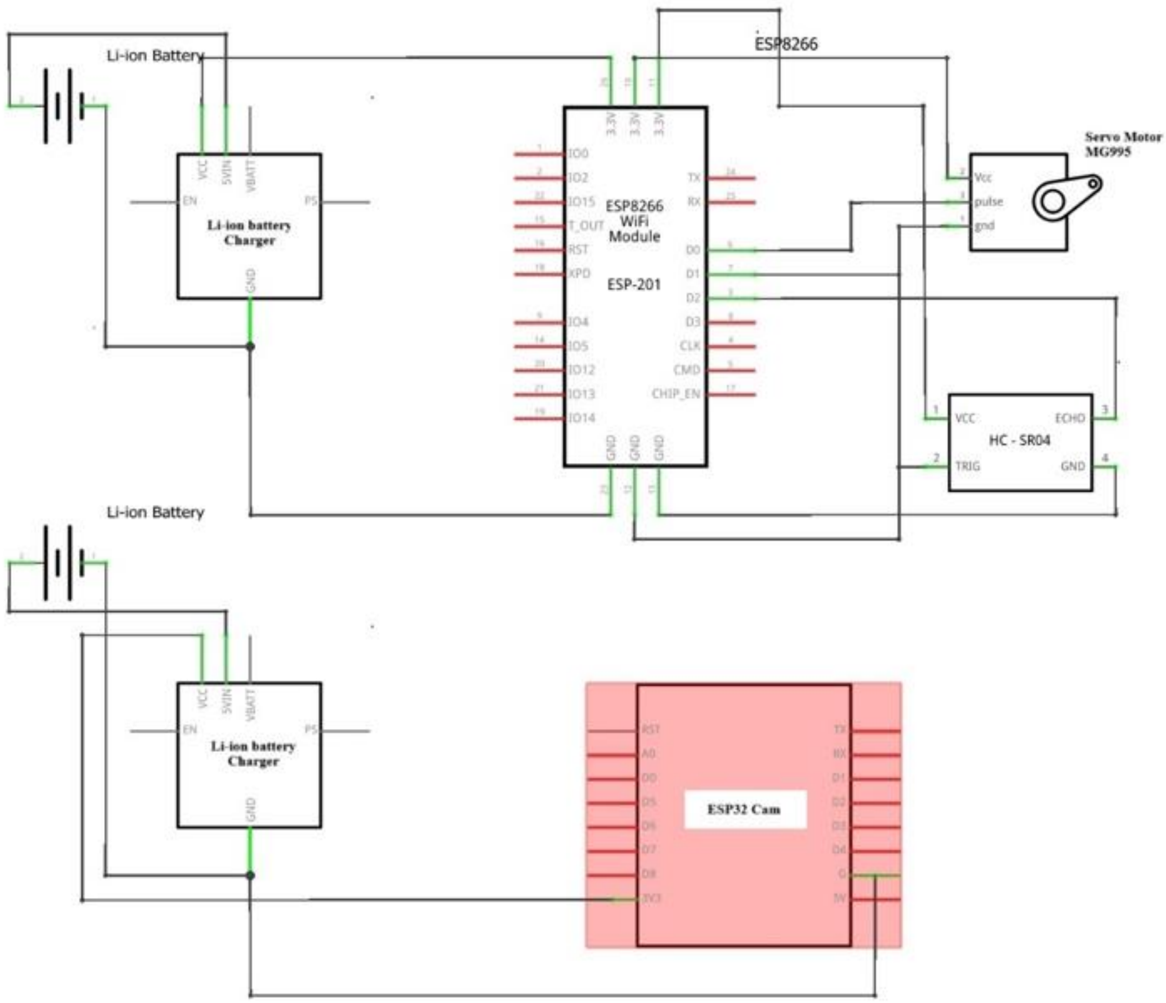


**Fig. 9**

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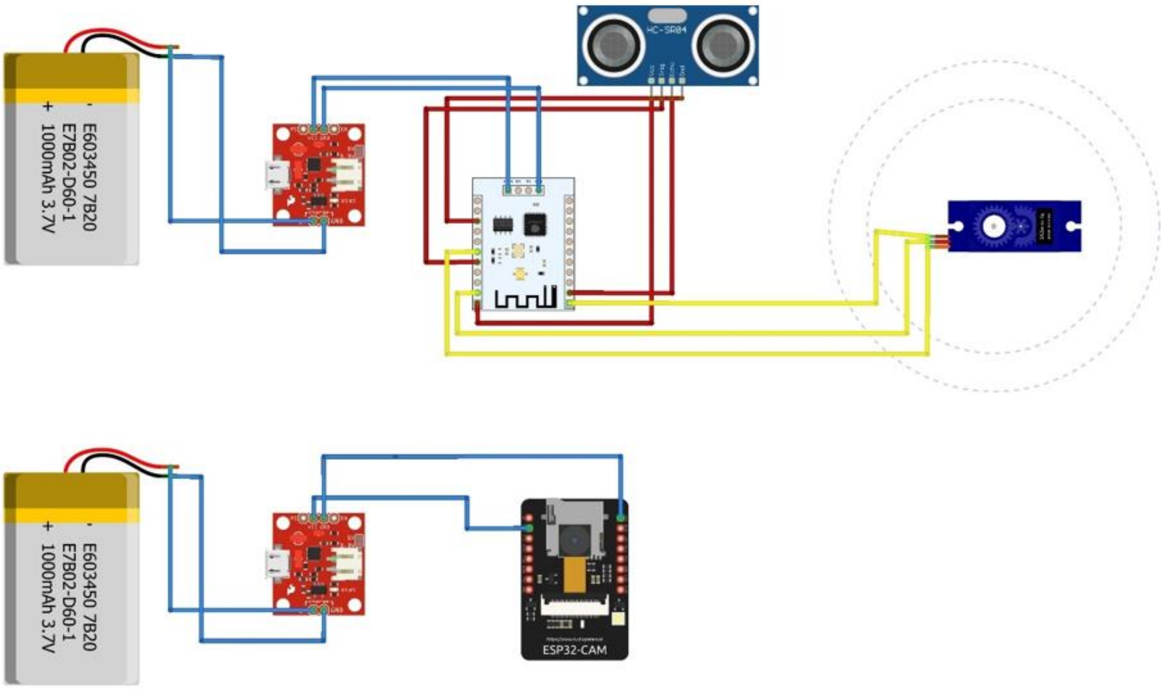


**Fig. 10**

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**FORM 2**
**THE PATENTS ACT, 1970**
**(39 OF 1970)**
**&**
**THE PATENTS RULES, 2003**
**COMPLETE SPECIFICATION**
**(See section 10; rule 13)**

**Title: SMART SURGICAL ASSISTANT GRIPPER AND METHOD THEREOF**

**APPLICANT DETAILS:**


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**(b) NATIONALITY:** Indian

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**PREAMBLE TO THE DESCRIPTION:**
The following specification particularly describes the nature of this invention and the manner in which it is to be performed.

**SMART SURGICAL ASSISTANT GRIPPER AND METHOD THEREOF**

## FIELD OF INVENTION:

The present invention relates to a smart surgical assistant gripper and method thereof. Particularly, the invention provides a smart gripper which enhances the efficiency and accuracy of surgical procedures by automating the instrument selection and retrieval process, thereby addressing the need for precision and reliability in surgical environments.

## BACKGROUND OF THE INVENTION:

The following background discussion includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication expressly or implicitly referenced is prior art.

Historically, surgery has been performed by making relatively large incisions in a patient to access a surgical site. More recently, robotic surgery allows a surgeon to perform procedures through relatively small incisions. As an example, in robotic endoscopy, the robot passes an endoscope through a small incision, and the endoscope includes a camera that allows the surgeon to view the patient's internal organs. Robotic procedures tend to be less traumatic and have shorter recovery times, than conventional surgical procedures.

Representative examples of procedures that can be performed using robotic surgery include heart surgery, lung surgery, prostate surgery, hysterectomies, joint surgery, and back surgery.

Of late, collaborative robots are increasingly becoming popular in various sectors such as manufacturing, healthcare, pharmaceuticals, etc. Their main advantage is to be able to work with humans without being confined to a robotic cell, as they are usually safe to work alongside humans due to advanced sensing capabilities that enable them to stop on sensing close proximity to a human.

As collaborative robotic technology advances, there is the need to make them smarter and sleeker so that they can operate with limited additional equipment. Any such robot typically requires end effectors to be able to manipulate objects and these end effectors often require additional wiring, controls and instrumentation to be added to the cobot. Pneumatic end effectors will often require an additional air compressor for functioning as well. As such, there is a need for minimalist design approaches, which can lead to reduced floor space usage, portability of cobotics systems to new locations of use, quicker response times and intelligent adaptation to new environments.

As such, there is a need for a smart gripper which can perform atleast the following functions:

1. Assisting users and operators of cobots in manipulation, movement and transfer of objects with wireless operation and self-powering using onboard power sources
2. Detecting objects based on voice commands given by operators and users using speech processing
3. Identifying objects and localizing gripper movements for pick up and transfer using a camera and on-board image processing capabilities within the gripper
4. Using on-board sensors in achieving precision in localizing gripper movements for object manipulation
5. Specific use in healthcare settings necessitating manipulation of stainless steel surgical instruments
6. Enabling remote operation of collaborative robots without the need for manual intervention using the cobot accessories such as a teach pendant

Particularly, there is a need of a system that can identify surgical instruments autonomously using an on-board component such as a camera which can be combined with machine learning capabilities processing the images from the camera and synchronizing the same with user commands received as a speech signal. The collaborative robot has the ability to receive precise coordinates which can be based on the location of the identified instrument, enabling it to retrieve the specified instrument efficiently. To complete the instrument pick up process, a sensor such as an ultrasonic sensor can effectively detect the instrument's proximity to the gripper attached to the cobot, ensuring secure and reliable grasping by the gripper.

In a nutshell, there is a need of a Smart Surgical Assistant Gripper which significantly improves surgical efficiency by automating the instrument selection and retrieval process by reducing the potential for human error and enhancing the overall workflow in surgical settings.

## OBJECTIVE OF THE INVENTION:

The primary objective of the present invention is to overcome the drawbacks associated with prior art.

Another object of the present invention is to provide a smart surgical assistant gripper which enhances the efficiency and accuracy of surgical procedures by automating the instrument selection and retrieval process.

Another object of the present invention is to provide a smart surgical assistant gripper which is smarter and sleeker so that it can operate with limited additional equipment.

Another object of the present invention is to provide a smart surgical assistant gripper which has minimal design and can lead to reduced floor space usage, has portability of cobotics systems to new locations of use, can provide quicker response times and intelligent adaptation to new environments.

Another object of the present invention is to provide a smart, autonomous wireless gripper which works well in healthcare settings in conjunction with doctors and nurses, and will be of use in operating theatre settings, where surgical procedures are carried out.

Another object of the present invention is to provide a smart, autonomous wireless gripper which can perform speech processing combined with AI-based image processing of live video stream.

Another object of the present invention is to provide a smart, autonomous wireless gripper which facilitates precise localization of a gripper for selecting the correct surgical instrument and manipulating the same based on live video feed and sensor data.

Another object of the present invention is to provide a smart, autonomous wireless gripper which has on-board power management for the operation of camera, sensor and actuator using rechargeable battery sources

Another object of the present invention is to provide a method of operation of the smart surgical assistant gripper.

## **SUMMARY OF THE INVENTION:**

In an aspect the present invention provides a smart surgical wireless gripper for gripping an instrument according to a user’s command for a collaborative robot, comprising:

a) an outer casing (15) below which is the top part (13) to carry a microcontroller board (14) that is connected to the internet using a wireless antenna, a speech processor which listens to user’s command and processes the speech to text followed by processing the text in a computer to send the detected text to the microcontroller board, an on-board wireless camera with an image recognition module (17) for image recognition based on the user's command, gears connecting an internal servo motor (12) to the gripper jaws, a battery unit (20, 21) comprising two on-board batteries which supplies power separately to the wireless camera and the microcontroller board, a servo motor (12) and a distance measurement sensor (18);

b) a mid part (10) holding the servo motor and connecting the top part with the bottom part through plurality of screws;

c) a bottom part (1) for positioning gears (3) and servo gears (4), ball bearings (2), steel cylindrical rollers (5), gripper jaws (6) with rubber case (7) and attachment (8);

wherein depending on the instrument type requested by the user using a voice command, the co-ordinates of the instrument are calculated from the images taken by the wireless camera and then passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument;

characterised in that the distance measurement sensor comprises an ultrasonic distance sensor (18) or an infra-red sensor, connected to the microcontroller board through general-purpose input/output pins and works in its coordination to power the servo motors at the right times, to determine the accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument by calculating the distance between the surgical instrument and the gripper;

once this distance is less than a threshold specific for that instrument, the gripper jaws are actuated by the servo motor and thereafter the gripper is withdrawn to the user's/doctor's palm to hand it over to the doctor.

The Invention provides a method of gripping an instrument according to a user's command for a collaborative robot, comprising the steps of:

a) Upon powering the system On, the microcontroller board and the camera boards connect to a wifi hotspot to connect to the internet while at the same time, a laptop/PC which is on the same network as the wifi hotspot runs an algorithm to start looking for speech signals from the user and the live video stream from the camera is also visible on the laptop/PC;

b) as soon as the speech signal from the user matches a trained signal corresponding to any of the surgical instruments in the instrument tray, the gripper starts looking for that instrument in the tray, which further by using an image processing algorithm that has embedded artificial intelligence obtained by training with a large number of images, the correct instrument corresponding to the speech command by the user/doctor is located and a green box is drawn around the instrument within the image stream;

c) localising the required instrument with specific co-ordinates by using the edges of the instrument tray as marker points and once the co-ordinates of the instrument have been identified, these are then sent to the collaborative robot to move close to the instrument, such that once the gripper is close to the instrument, the distance measurement sensor senses the closeness of the gripper jaws to the actual object;

wherein depending on the instrument type, the co-ordinates of the instrument are then passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument;

characterised in that the distance measurement sensor comprises ultrasonic distance sensor (18) or an infra-red sensor, connected to the microcontroller board through general-purpose input/output pins and works in its coordination to power the servo motors at the right times, to determine the accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument by calculating the distance between the instrument and the gripper;

once this distance is less than a threshold specific for that instrument, the gripper jaws are actuated by the servo motor and thereafter the gripper is withdrawn to the user's/doctor's palm to hand it over to the doctor.

## DETAILED DESCRIPTION OF DRAWINGS:

To further clarify advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of their scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings in which:

Fig. 1: Illustrate Gripper installed on the collaborative robot showing various system components

Fig. 2: Illustrate ESP8266 Nodemcu micro-controller board

Fig. 3: Illustrate ESP32 camera

Fig. 4: Illustrate Detailed drawing of the smart gripper (Isometric exploded view)

Fig. 5: Illustrate Detailed drawing of the smart gripper (Another isometric exploded view)

Fig. 6: Illustrate the smart gripper, shown in isolation

Fig. 7: Illustrate top view and side view of the gripper

Fig. 8: Illustrate a comprehensive illustration of the gripper's functioning

Fig. 9: Illustrates gripper wiring diagram

Fig. 10: Illustrates gripper circuit connection

## DETAILED DESCRIPTION:

For the purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated system, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof.

The terms “comprises”, “comprising”, “includes”, or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a setup, device or method that comprises a list of components or steps does not include only those components or steps but may include other components or steps not expressly listed or inherent to such setup or device or method. In other words, one or more elements in a system or apparatus proceeded by “comprises... a” does not, without more constraints, preclude the existence of other elements or additional elements in the system or method.

The Invention provides a smart surgical assistant gripper and method thereof. The smart gripper enhances the efficiency and accuracy of surgical procedures by automating the instrument selection and retrieval process, thereby addressing the need for precision and reliability in surgical environments. The smart gripper integrates a camera and machine learning algorithms to process and identify images of surgical instruments. It also incorporates speech recognition technology to interpret user commands and determine which instrument to pick up. Upon matching the identified speech command with the recognized instrument, the system transmits the coordinates to a collaborative robot for precise and efficient retrieval. Additionally, an ultrasonic or infra-red sensor is employed to detect the proximity of the instrument, signalling when to close the gripper for secure grasping.

The system accurately identifies surgical instruments using its camera and machine learning capabilities. The speech recognition component successfully interprets user commands and matches them with the identified instruments. The collaborative robot receives precise coordinates, enabling it to retrieve the specified instrument efficiently. The ultrasonic sensor effectively detects the instrument's proximity, ensuring secure and reliable grasping by the gripper.

The Smart Surgical Assistant Gripper significantly improves surgical efficiency by automating the instrument selection and retrieval process. It reduces the potential for human error and enhances the overall workflow in surgical settings. This intelligent solution offers a reliable and precise method for managing surgical instruments, contributing to better surgical outcomes.

In an embodiment, the smart surgical assistant/wireless gripper is built using an inventive integration of several individual technical artefacts. An overall system diagram together with the collaborative robot, is shown in Figure 1.

The smart gripper has atleast following essential technical features:

- Smart wireless operation of a gripper for human-robot collaborative surgery based on speech processing combined with AI-based image processing of live video stream
- Autonomous, precise localization of a gripper for selecting the correct surgical instrument and manipulating the same based on live video feed and sensor data
- On-board power management for operation of camera, sensor and actuator using rechargeable battery sources

One of the technical features of the invention is to get away from wired grippers, to achieve the autonomous, precise gripping solutions that take advantage of simultaneous speech and image processing capabilities. One of the essential technical feature is the geometry of the gripper body which encompass the key components in desired locations along with the intelligent self-written algorithms that are specifically tuned for surgical instruments and made to run in a specific order, and finding thresholds where precise localization of the gripper and instrument is simultaneously worked out using an integration of camera feed and sensor data without human intervention.

In an embodiment, the device (referring to Fig. 4 – Fig. 6) is mounted on a collaborative robot using an adapter plate that mates with the tool flange of the cobot on one side and with the gripper on the other side.

**The smart gripper as shown in Figure 4 and 5 has following parts:**

| Part Number | Part Name |
|---|---|
| 1 | Bottom part |
| 2 | Ball Bearings 5x13x4 mm |
| 3 | Gears |
| 4 | Servo Gear |
| 5 | Steel cylindrical rollers |
| 6 | Jaws |
| 7 | Jaw Rubber case |
| 8 | Jaw attachment |
| 9 | M3x30 mm Screws |
| 10 | Mid part |
| 11 | M4x45mm Screws |
| 12 | Servo Motor MG996R |
| 13 | Top part |

| | |
|---|---|
| 14 | ESP8266 Microcontroller part |
| 15 | Top case |
| 16 | M4x50 mm Screws |
| 17 | ESP32 cam |
| 18 | Ultrasonic sensor HC-SR04 |
| 19 | Spacer |
| 20 | Li-ion battery 1 |
| 21 | Li-ion battery 2 |

**Table 1.** Nomenclature for parts in Fig. 4 and Fig. 5

In an embodiment, the gripper comprises an outer casing that is 3D printed and carries within it a microcontroller board that is connected to the internet using a wireless antenna, an on-board wireless camera, a battery unit comprising two on-board batteries, a servo motor and a distance measurement sensor.

The Invention comprises two types of distance measurement sensors, which have also been tested and found to work: an ultrasonic sensor and an infra-red sensor. Only one of these sensors is required for the distance measurement algorithm to work. A program running on a computer listens to the commands of the doctor for a specific surgical instrument and then turns on the wireless camera on the gripper to start searching for that instrument. The instrument is detected using a machine learning (artificial intelligence) algorithm that has been trained to recognize various surgical instruments. This algorithm then localizes the instrument based on four ArUco markers placed at the four corners of the surgical instrument tray. Depending on the instrument type requested, the co-ordinates of the instrument are then calculated and passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument. The gripper’s jaws are specifically designed to be able to pick up a wide range of instruments such as straight and curved scissors, dissection clamps, etc. and optionally carry a magnet at the end to enable a robust pick-and-place operation. Accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument is determined by the distance measurement sensor working in coordination with an algorithm on the microcontroller board that powers the servo motors at the right times. The on-board batteries supply power separately to the wireless camera and the microcontroller board. The microcontroller board is connected to the distance measurement sensor through general-purpose input/output pins.

In a specific embodiment, the gripper body, is 3D printed, comprises an outer body, gripper jaws, gears connecting an internal servo motor to the jaws, spacers and an adapter plate that connects the tool flange of the collaborative robot arm to the gripper. Slots have been made on the outer body for two switches, an USB power port, a camera and sensor mount. Within the gripper body are placed an ESP 8266 microcontroller board (Fig. 2), an ESP-32 camera (Fig. 3), a MG 995 metal gear servo motor, a MT3608 step up power booster chip, a TP4056 USB-Type C charger, a battery holder with a rechargeable 3.7 V battery and a 1000 mAh battery unit which is typically used in smartphones. On the exterior, an ultrasonic distance sensor HC-SR04 or alternately, an infra-red sensor, LM393 photoelectric module, is placed. Two switches are placed on either side of the gripper to enable the on-board camera or alternately, the servo motor unit. The ESP 8266 board is typically powered by the rechargeable battery placed on board in the battery holder while the camera unit is powered by another rechargeable battery placed on board in another battery holder. The other combination, swapping the batteries, has also been tested and was also found to be a viable option.

When the system is powered on, the ESP-8266 board and the ESP-32 camera boards connect to a wifi hotspot that is generated specifically for these boards to connect to the internet. At the same time, a laptop/PC which is on the same network as the wifi hotspot, runs an algorithm to start looking for speech signals from the user. A live video stream from the camera is also visible on the laptop/PC.

As soon as the speech signal from the user matches a trained signal corresponding to any of the surgical instruments in the instrument tray, the gripper starts looking for that instrument in the tray. Using an image processing algorithm that has embedded artificial intelligence obtained by training with a large number of images, the correct instrument corresponding to the speech command by the user/doctor is located and a green box is drawn around the instrument within the image stream. Next, that instrument is localized with specific co-ordinates by using the edges of the instrument tray as marker points. These edges are uniquely identified by ArUco marker, which have been placed on the edges, as shown in Figure 1. Once the co-ordinates of the instrument have been identified, these are then sent to the collaborative robot to move close to the instrument. Once the gripper is close to the instrument, the distance measurement sensor (ultrasonic or IR) senses the closeness of the gripper jaws to the actual object. Once this distance is less than a threshold (calculated by a program which is stored on the micro-controller board), which is specific for that instrument, the gripper jaws are actuated using the servo motor. Then the gripper is withdrawn to the doctor's palm location to hand it over to the doctor.

The gripper's jaws are specifically designed to be able to pick up a wide range of instruments such as straight and curved scissors, dissection clamps, etc. and optionally carry a magnet at the end to enable a robust pick-and-place operation. The design of the gripper's jaws are in the shape of converging triangular cross-sections with a flat surface at the end (Fig. 4 – Fig. 6).

Fig. 8 shows a comprehensive illustration of the gripper's functioning. It shows the manner in which the gripper integrates multiple functions like processing speech and Image recognition, to regulate the gripping function of the gripper. The gripper system comprises the use of a python speech recognition library to process the speech to text and Yolo V5 vision artificial intelligence (AI) which is trained using custom data to detect the medical instrument. These functions are carried out on a laptop. Further, by using ESP 32 cam in the gripper it detects the medical instruments in the tray. This further get processed in the computer followed by cross checking with the detected medical instruments and matching with the required medical instrument.

The speech processing is performed by a python speech recognition library for processing the speech to text. The speech processor recognises the speech and processes the text in a computer followed by sending the detected text to the image recognition model. Based on the detected text, this model then looks for the specific instrument in the tray images sent by the ESP-32 cam board within the gripper. Once the instrument is found in the image, its coordinates are determined with respect to the coordinates of the ArUco markers in the image as reference points.

In an embodiment, there are atleast four ArUco markers placed at the four corners of the surgical instrument tray which acts as the reference point/ origin point for gripping a surgical instrument as required by the user and detected by the camera. A calibration procedure preceding the starting of the gripper system helps set the ArUco marker coordinates in the global coordinate frame of the collaborative robot. The ArUco markers are used to determine the pixel coordinates of the medical instrument and convert the pixel coordinate to base coordinate in the collaborative robot system and to then send the details to the control unit of the collaborative robot through socket communication.

The gripper comprises a ESP 8266 NodeMcu microcontroller board to control its gripping actions. Depending on the instrument type, the co-ordinates of the instrument are then passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument. The distance measurement sensor comprises ultrasonic distance sensor (18) or an infra-red sensor, connected to the micro-controller board through general-purpose input/output pins and works in its coordination to power the servo motors at the right times, to determine the accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument by calculating the distance between the instrument and gripper. Once this distance is less than a threshold specific for that instrument, the gripper jaws are actuated by the servo motor and thereafter the gripper is withdrawn to the user's/doctor's palm to hand it over to the doctor. The threshold is calculated by a program which is stored on the microcontroller board.

Dated this 27th day of August 2024

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Of **RNA, IP Attorneys**
Agent for the Applicant

**We Claim:**

1. A smart surgical wireless gripper for gripping an instrument according to a user’s command for a collaborative robot, comprising:

    a) an outer casing (15) below which is the top part (13) to carry a microcontroller board (14) that is connected to the internet using a wireless antenna, a speech processor which listens to user’s command and processes the speech to the text followed by processing the text in a computer to send the detected text to the microcontroller board, an on-board wireless camera with an image recognition module (17) for image recognition based on the user’s command, gears connecting an internal servo motor (12) to the gripper jaws, a battery unit (20, 21) comprising two on-board batteries which supplies power separately to the wireless camera  and the microcontroller board, a servo motor (12) and a distance measurement sensor (18);

    b) a mid part (10) holding the servo motor and connecting the top part with the bottom part through plurality of screws;

    c) a bottom part (1) for positioning gears (3) and servo gears (4), ball bearings (2), steel cylindrical rollers (5), gripper jaws (6) with rubber case (7) and attachment (8);

    wherein depending on the instrument type requested by the user using a voice command, the co-ordinates of the instrument are calculated from the images taken by the wireless camera and then passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument;

    characterised in that the distance measurement sensor comprises ultrasonic distance sensor (18) or an infra-red sensor, connected to the microcontroller board through general-purpose input/output pins and works in its coordination to power the servo motors at the right times, to determine the accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument by calculating the distance between the instrument and gripper;

    once this distance is less than a threshold specific for that instrument, the gripper jaws are actuated by the servo motor and thereafter the gripper is withdrawn to the user’s/doctor’s palm to hand it over to the doctor.

2. The gripper as claimed in claim 1, comprises four ArUco markers placed at the four corners of the surgical instrument tray, which act as the reference points for gripping a surgical instrument as required by the user and detected by the camera;

   said ArUco markers are used to extract the pixel coordinates of the medical instrument with respect to the markers and then the pixel coordinates are converted to base coordinates, to send the details to the control unit of the collaborative robot through socket communication.

3. The gripper as claimed in claim 1, wherein the image recognition module (17) comprises Yolo V5 computer vision model, which is trained by custom data to detect the medical instrument through camera as required by the user, and sends the information to the processor in computer for further verification/ checking of the detected medical instruments with respect to the required medical instrument as asked by the user’s speech command.

4. The gripper as claimed in claim 1, wherein an in-built microphone or an external connected mic is used to gather speech signals and are processed using a speech recognition library written in the python programming language to process the same to text in a computer.

5. The gripper as claimed in claim 1, is mounted on a collaborative robot by an adapter plate that mates with the tool flange of the cobot on one side and with said gripper on the other side.

6. The gripper as claimed in claim 1, wherein the gripper’s jaws are specifically designed to be able to pick up a wide range of instruments such as straight and curved scissors, dissection clamps and carry a magnet at the end to enable a robust pick-and-place operation.

7. The gripper as claimed in claim 1, comprises a NodeMcu which is an open-source firmware and development kit to control its gripping actions.

8. The gripper as claimed in claim 1, wherein the outer casing comprises slots for two switches placed on either side of the gripper to enable the on-board camera or alternately the servo-motor unit, a USB power port, a camera and sensor mount, a power booster chip, a USB-Type C charger, a battery holder with a rechargeable 3.7 V battery.

9. The gripper as claimed in claim 1, wherein microcontroller is powered by the rechargeable battery placed on board in the battery holder while the camera unit is powered by another rechargeable battery placed on board in another battery holder.

10. The gripper as claimed in claim 1, wherein the gripper's jaws are in the shape of converging triangular cross-sections with a flat surface at the end, to be able to pick up a wide range of instruments such as straight and curved scissors, dissection clamps, and also carry a magnet at the end to enable a robust pick-and-place operation.

11. A method of gripping an instrument according to a user's command for a collaborative robot, comprising the steps of:

    a) Upon powering the system On, the microcontroller board and the camera board connect to a wifi hotspot to connect to the internet while at the same time, a laptop/PC which is on the same network as the wifi hotspot runs an algorithm to start looking for speech signals from the user and the live video stream from the camera is also visible on the laptop/PC;

    b) as soon as the speech signal from the user matches a trained signal corresponding to any of the surgical instruments in the instrument tray, the gripper starts looking for that instrument in the tray, which further by using an image processing algorithm that has embedded artificial intelligence obtained by training with a large number of images, the correct instrument corresponding to the speech command by the user/doctor is located and a green box is drawn around the instrument within the image stream;

    c) localising the required instrument with specific co-ordinates by using the edges of the instrument tray as marker points and once the co-ordinates of the instrument have been identified, these are then sent to the collaborative robot to move close to the instrument, such that once the gripper is close to the instrument, the distance measurement sensor senses the closeness of the gripper jaws to the actual object;

wherein depending on the instrument type, the co-ordinates of the instrument are then passed to the collaborative robot so that the robotic arm can move to the correct position and pick up the surgical instrument;

characterised in that the distance measurement sensor comprises ultrasonic distance sensor (18) or an infra-red sensor, connected to the micro-controller board through general-purpose input/output pins and works in its coordination to power the servo motors at the right times, to determine the accurate positioning and actuation of the gripper jaws at the moment the gripper reaches the surgical instrument by calculating the distance between the instrument and gripper;

once this distance is less than a threshold specific for that instrument, the gripper jaws are actuated by the servo motor and thereafter the gripper is withdrawn to the user’s/doctor’s palm to hand it over to the doctor.

12. The method as claimed in claim 11, wherein the threshold is set within a program which is stored on the microcontroller board and is dependent on the type of distance measurement sensor used

Dated this 27th day of August 2024

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Regd. Patent Agent [IN/PA-1592**]**
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## ABSTRACT

### SMART SURGICAL ASSISTANT GRIPPER AND METHOD THEREOF

The present invention relates to a smart surgical assistant gripper and method thereof. Particularly, the invention provides a smart gripper which enhances the efficiency and accuracy of surgical procedures by automating the instrument selection and retrieval process, thereby addressing the need for precision and reliability in surgical environments.

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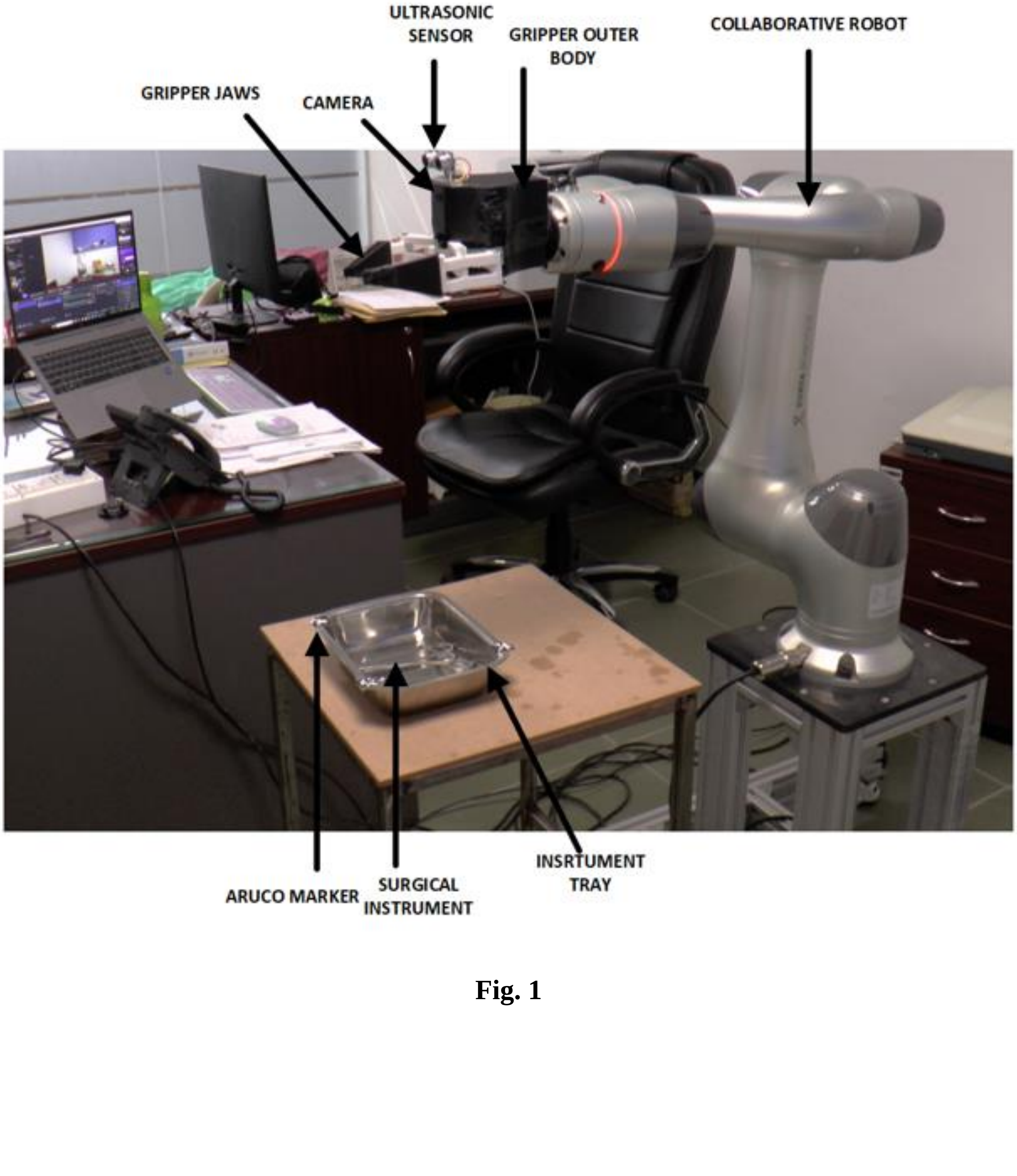


**Fig. 1**

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**Fig. 2**


**Fig. 3**

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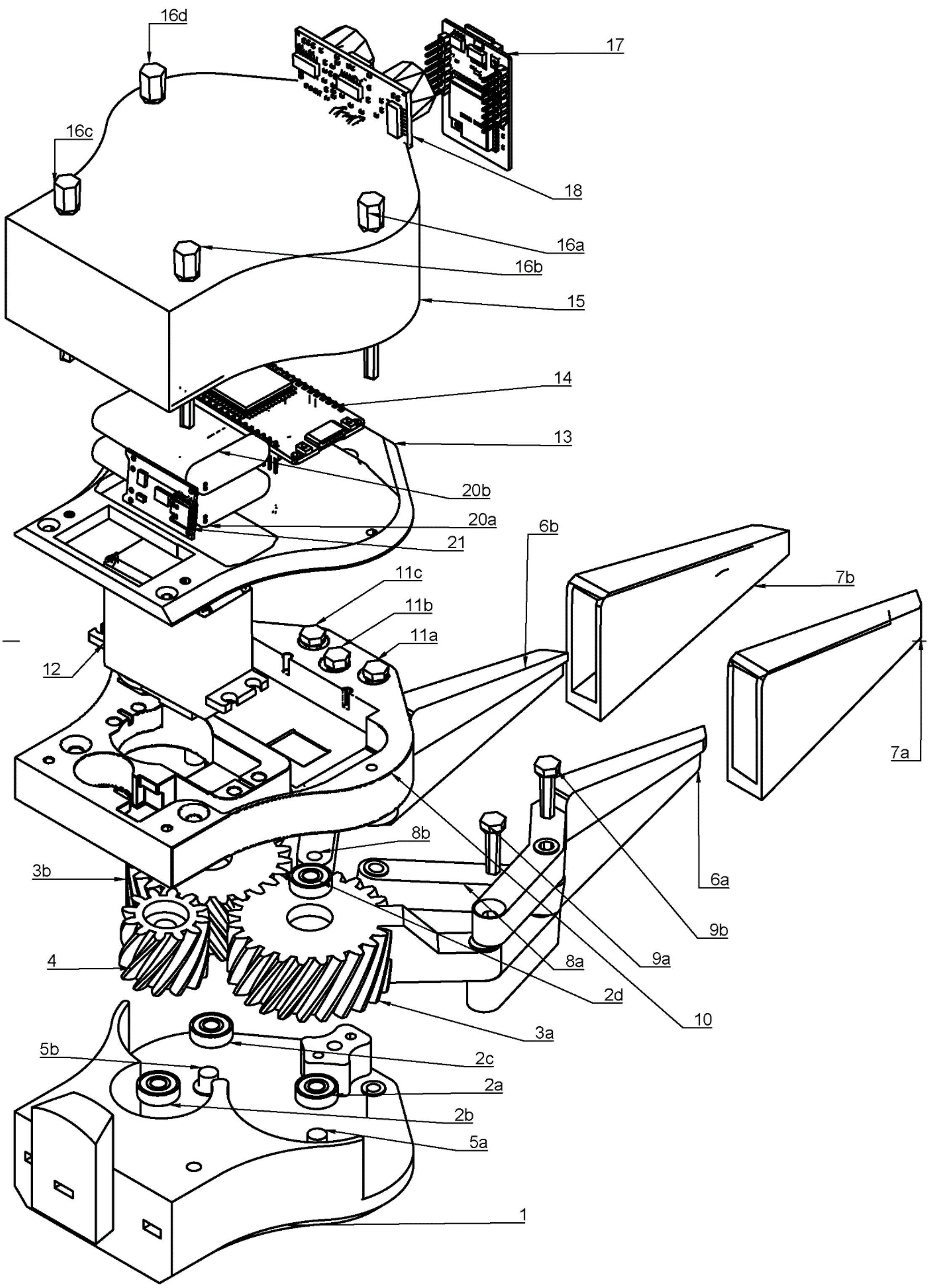


**Fig. 4**

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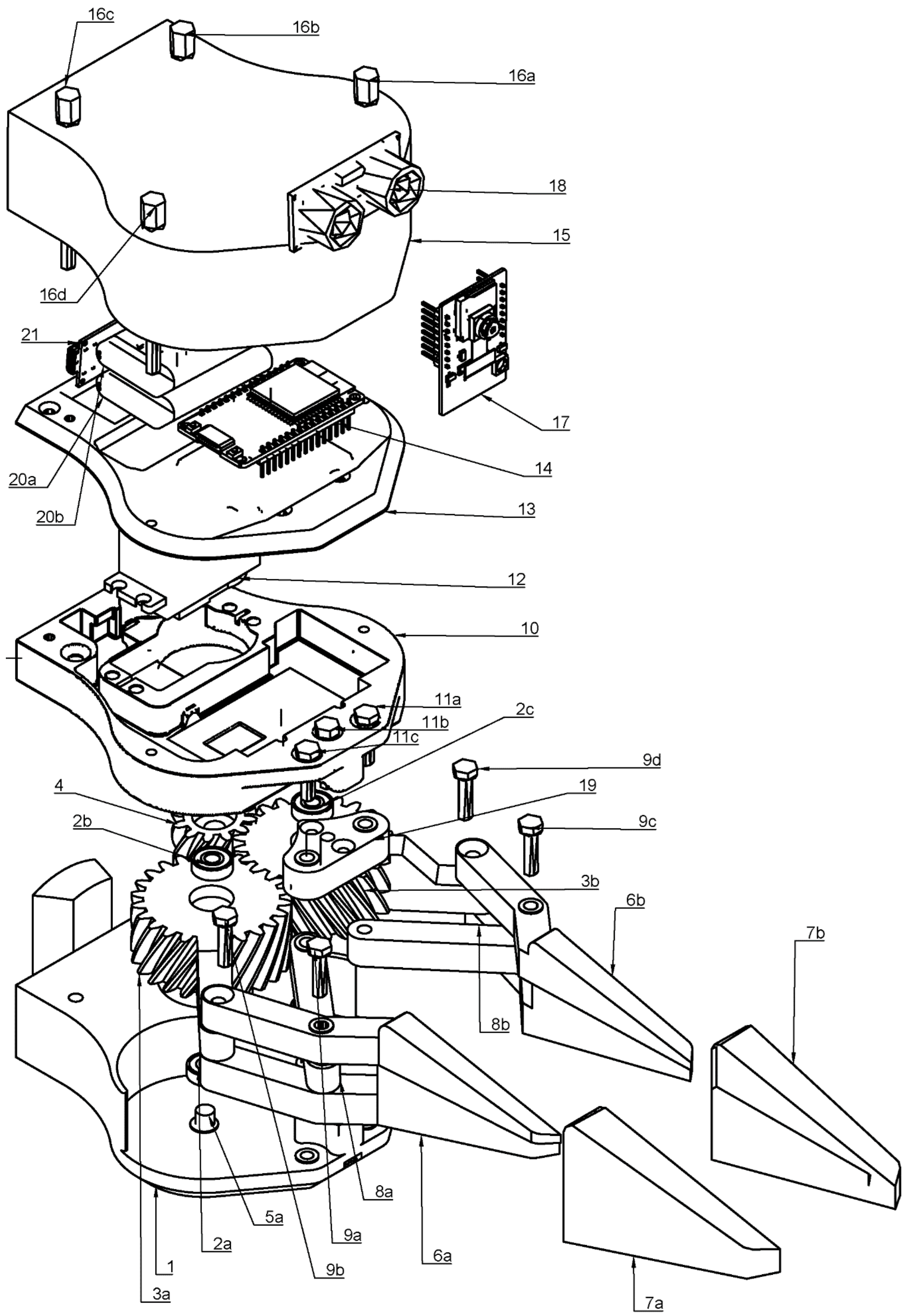


**Fig. 5**

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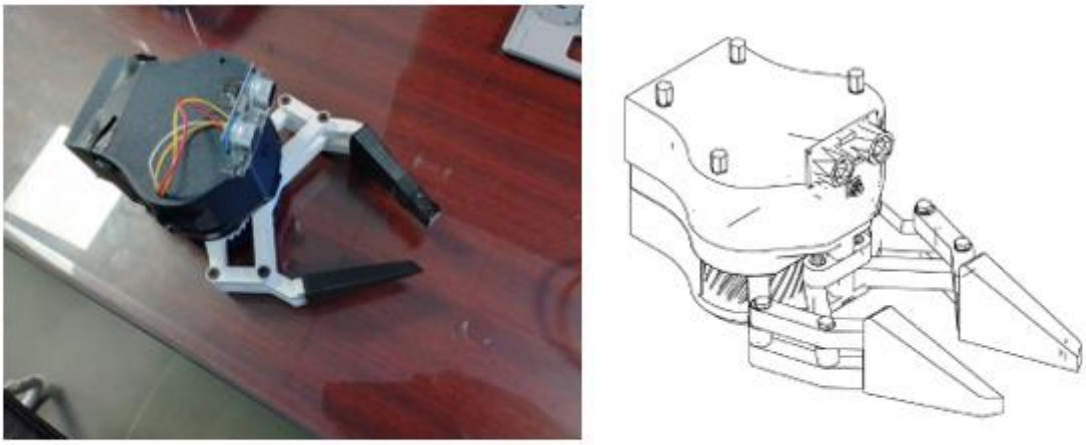

**Fig. 6**

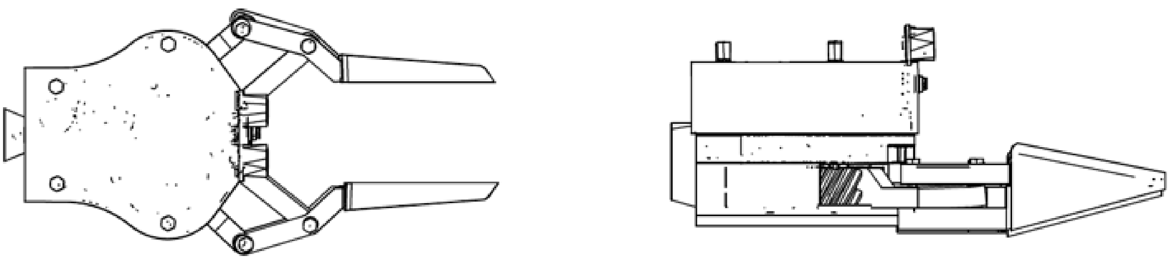

**Fig. 7**

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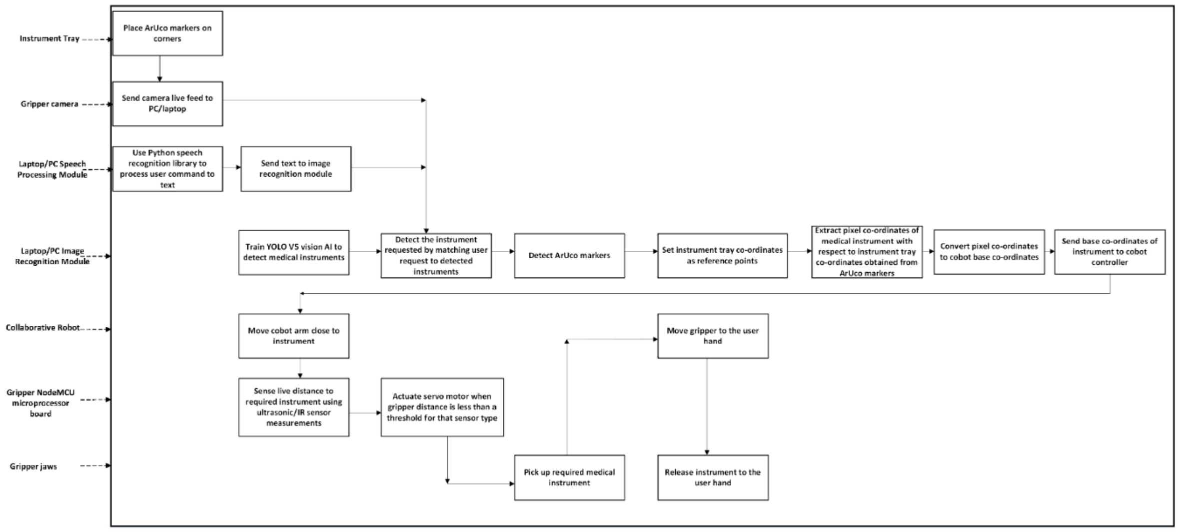


**Fig. 8**

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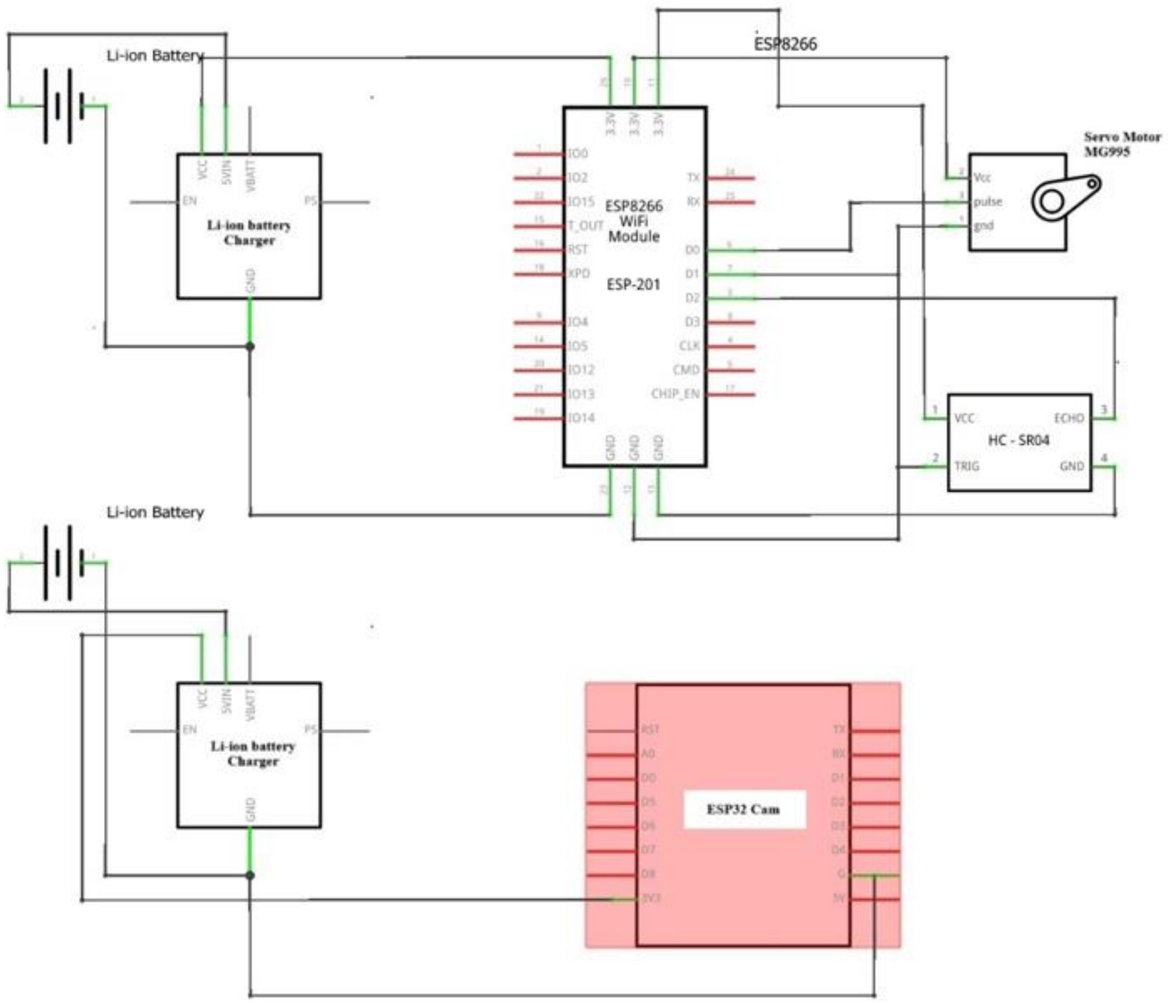


**Fig. 9**

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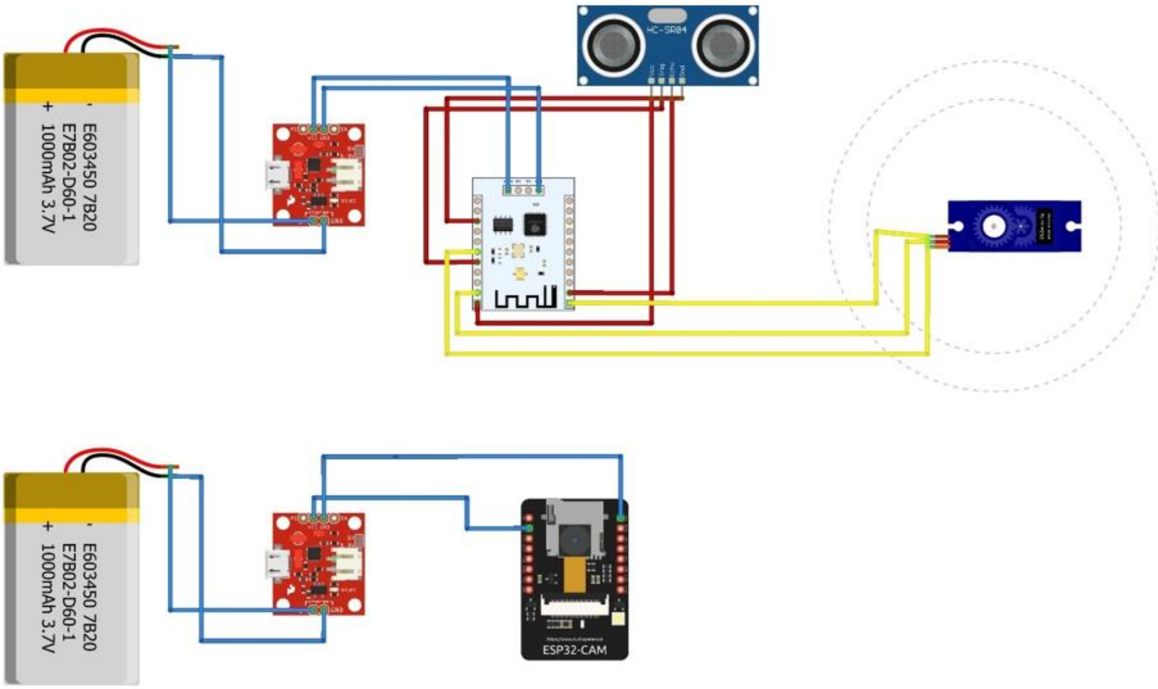


**Fig. 10**

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