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The Method of Taking the Blessing Ball for Manual Robots at the 2018 Indonesian Robot Contest

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ABSTRACT

KRAI (Indonesian Abu Robot Contest) is a robotics contest between Higher Education in Indonesia. Indonesian ash robot contest organized by the Directorate General of Higher Education (DIRJEN DIKTI). The winner of the KRAI will represent Indonesia in the ABU (Asia-Pacific Broadcasting Union) Robocon which is held annually with locations moving around within ABU member countries. KRAI 2018 made a blessing ball picking robot with a gripper. The parameter that must be achieved is that the optimization of the robot drive can take the blessing ball. The design of the blessing ball picking mechanic can use the servo gripper by determining the slope of the robot. The angle of inclination of the robot determines the taking of the ball. Based on the results of the study, the results were obtained by testing carried out taking test data with an angle of 20˚-50˚. The robot can pick up when 1 ball with that angle. Testing with an angle of 50˚-80˚. The robot can take 2 balls with that angle. Testing with an angle of 80˚-110˚. The robot can take 3 balls with that angle. With an angle of 110˚-140˚. The robot can take 2 balls. With a blade of 140˚-170˚ the robot can take 1 ball. In the method of taking the ball in the 10 tests that have been carried out, there are experiments that are declared efficient to be able to take 3 balls with a 100% success percentage in an average time of 21 seconds. So it can be implied that the tester at the ball picking used an angle of 80˚-110˚more efficiently than the angle of 20˚-80˚and 110˚-170˚.

1. Introduction

KRAI (Indonesian Abu Robot Contest) is a robotics contest between universities in Indonesia. Indonesian ash robot contest organized by the Directorate General of Higher Education (DIRJEN DIKTI) [1]. In KRAI in 2018 there are two robots that can consist of one manual robot and an automatic robot or both are automated, but only one manual robot can take the blessing of the winner from KRAI will represent Indonesia in the ABU (Asia-Pacific Broadcasting Union) Robocon which is held annually with locations moving around within ABU member countries. KRAI 2018 created a blessing ball picking robot with a gripper [2]. The parameter that must be achieved is that the optimization of the robot drive can take the blessing ball. The mechanical design of blessing ball picking on the KRAI robot can use a servo gripper by determining the tilt angle of the robot [3]. The robot must adjust the position to be able to pick up the blessing orbs that have been arranged on the zig. Zig is a place to put or arrange the blessing ball so that the ball is not on the floor, in order for the robot to pick up the ball, it must adjust the gripper position on the robot must determine the angle so that the gripper robot can take the blessing ball and the robotic arm or gripper holder must match the height of the ball rope so that it does not hit the ball place or what is called a zig [4]. The manual

robot that will be in charge of picking the blessing ball uses 6 grippers divided into two upper positions 3 grippers down 3 grippers which are grinded using 6 DC 6V servo motors and using PG45 DC 24V motors [5]. The gripper grinded with the servo motor will move open and close to clamp the rope in the blessing ball that has been arranged in the zig and the function of the PG 45 motor here is to grind the sliding connected with a fan belt that can move up and down to adjust the height of the gripper arm at the time of retrieval in order to avoid a collision between the gripper and zig [6]. Gripper is part of a manual robot used for the process of retrieving blessing balls that have been zig. The gripper is designed according to the shape of the item to be taken. So, the design of the gripper adjusts to the shape of the rope that is in the blessing ball [7].

2. Robot KRAI

The robot is equipped with a gripper as a component for taking blessing balls that have been arranged on the shelf or can be said to be zig. The robot uses 6 grippers that are moved with a servo and arranged with two upper levels of 3 grippers and below 3 grippers of the upper gripper function to clamp the rope at the upper end of the beam ball and 3 more grippers to clamp the lower rope of the blessing ball. This robotic system uses Arduino mega as the overall controller of behavior and a 24-volt DC motor. As a robot mover when maneuvering in the arena, the Arduino Mega is used as much as one board.

2.1. Gripper Planning

Gripper design is the main function to hold an object or an object on a robot that functions to carry out the gripping process that is grinded with a servo motor. The servo motor used to grind the lever to open and close the gripper or function to clamp the servo is grinded with Arduino mega as the controller of the servo motor and grinds the gripper [8]. Gripers and mechanics make the robot more effectively work on blessing ball picking missions. There are parts for system design, namely the electronic part, the robot drive part, the physical part of the robot, and the robot program part. These parts will be the foundation for making robots. As for software design using a programming language by utilizing the Arduino IDE tool [10].

2.2. Robot Design Platform

The robot is designed with the required components such as servo, gripper, battery, motor driver, and gripper taking into account rarely with other grippers so that the gripper can maximally pick up and maximally open and close the gripper while the robot is running. The control robot is equipped with a microcontroller in the form of Arduino mega as the main control. The power source of the robot is diperole from two 12 volt Li-Po batteries to the lif motor and one 12 volt Li-Po battery to enter power to the Microcontroller, motor driver, servo motor and DC motor. For the robotic drive, it uses four 24-volt DC motors that are controlled with EMS 30 A drivers and use omniwheel wheels so that the robot can move freely.

2.3. Control System Block Diagram

Block control system Manual robot control uses a joystick control system, which is a robot that can be moved using wireless joystcik control to make it easier for jockeys or robot users to adjust the position of the robot or adjust the picking of the blessing ball so that the ball can be taken from the ball place called zig. The manual robot control system itself is described in the block diagram in Fig. 1.

In the block diagram of the manual robot, it can be explained that the input from the robot uses a wireless joystick with a frequency of 2.4Ghz. The microcontroller used is an Arduino Mega with output in the form of a DC motor for wheel drive, a forklift and a Servo motor for driving a robot gripper. The power supply used to operate the gripper of this robot is 12Volt using Lippo batteries. The joystick fully functions as the robot's gripper input, every movement of the robot will be adjusted to the circumstances or testing.

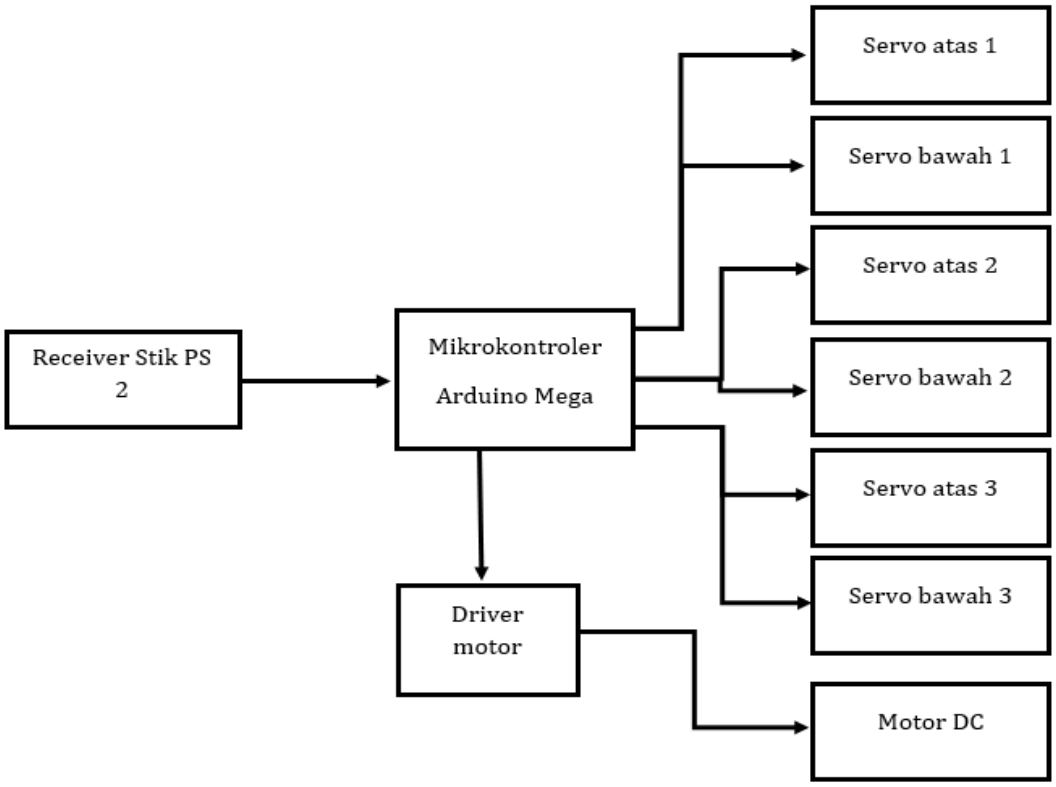


Fig. 1. System design diagram block

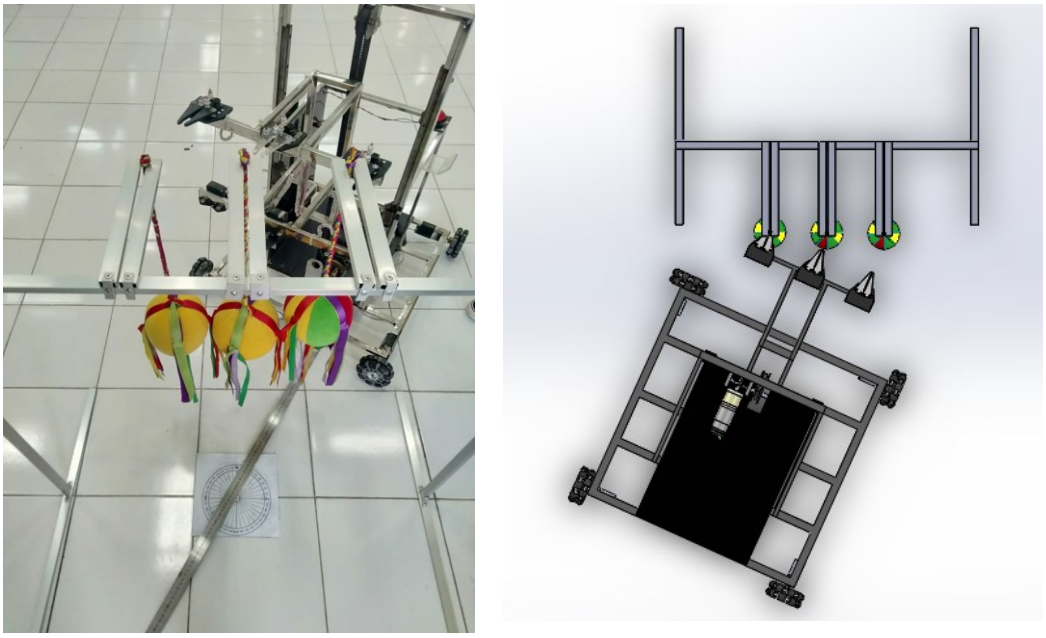
3. Method

The KRAI manual robot motion system uses a Joystick as a robot drive and the gripper receives input from the joystick as a servo drive and a servo as a gripper drive to open and close the gripper. Gripper is the main function to hold an object or an object on a robot that functions to carry out the gripping process that is grinded with a servo motor. The servo motor used to grind the lever to open and close the gripper or function to clamp the servo is grinded with Arduino mega as the controller of the servo motor and grinds the gripper. Gripers and mechanics make the robot more effectively work on blessing ball picking missions. There are parts for system design, namely the electronic part, the robot drive part, the physical part of the robot, and the robot program part. These parts will be the foundation for making robots.

3.1. Robot System Design

The provisions or regulations in the robot contest that have been set include the weight of the robot must not exceed 25 kg, height with a maximum of 100 cm, width with a maximum of 100 cm, and maximum length of 100 cm. No use of wind pressure exceeding In the KRAI regulation 2018 the robot's voltage power supply is not allowed to exceed 24 V [11]. The design of the frame or bottom frame of the robot uses 5 motors because it is limited by weight if you use many motors. In the 2018 KRAI Match using 2 robots, namely manual and automatic robots, manual robots are required to be able to take, give blessing balls to automatic robots. Automated robots are required to be able to throw at the target. Before realizing the mechanical physical form of the robot, it was made with the help of SOLIDWORK software to design first. The design created will make it easier to make the robot in its original form. The following is the design of the KRAI 2018 robot in Fig. 2.

The frame or frame is designed to place the gripper so that the gripper can be installed properly and can be used to pick up balls that have been installed on the ball rack with designed distance between grippers from each other with a distance of 15 cm. This is based on the fact that the gripper does not come into contact with other grippers.



(a) (b)

Fig. 2. Designing robot (a) and robot (b) systems

3.2. Electrical Control Unit Robot

In the manual robot control system of taking the blessing ball above, the robot gets commands through a joystick held by the operator or user who runs the robot, after the robot gets commands from the joystick, the commands will enter the Arduino as the main processor and process commands that will pass EMS 30 A (Embedded Module Series) on EMS 30A the incoming current will be filtered so that when discharging current to the motor and the motor can immediately move according to the motor operator's command can only move up and down in order to adjust the ball picking on the zig and EMS also holds the feedback current or backflow generated by the motor from entering directly on the microcontroller. And jongki can also gripper the servo motor through the joystick to grip the gripper to clamp the rope on the ball so that it can be carried by a manual robot as expected.

ECU (Electrical Control Unit) a system that controls robots to complete missions, this ECU (Electrical Control Unit) is made with fiber PCB boards. To design the PCB schematic by using the Eagle application to make it easier to make PCB paths. The creation of the data path will use a thickness of 0.8 mm while for the 5V power supply it uses a thickness of 1.0 mm. The creation of this path has been researched in advance, when the path making does not match the aesthetics of the basics of electrical engineering PCB will experience interference such as the PCB path will break.

The design of the ECU (Electrical Control Unit) uses a shield, which is a circuit to make the circuit compact not using many cables. In making Arduino shields using eagle software Arduino components are polished for easy installation. Mini system PCB design with a size of 15 cm x 15 cm, the minisystem path design is well made in the aesthetics of the basics of electrical engineering. In creating the path there will be a safety / fuse to anticipate when there is damage or short on the path. This fuse will protect several components such as Arduino, sensors, and other outputs. When there is a short circuit occurrence, the fuse will be disconnected. Put the minisystem 12 V, but this minisystem will be installed with UBEC. The function of UBEC as a voltage drop that was originally 12 V will be 5 V while the power supply needed in this minisystem is 5 V to supply Arduino, sensors, servos and others that require a power supply of 5 V. PCB output pins are installed IDE sockets so that the socket does not easily come off with the mini system. This circuit outputs Arduino input and output pins, examples of input pins are sensors that help the robot smarter. For the output pins, namely EMS, motor, servo, joystick. The following series of schematics and mini-systems in Fig. 3.

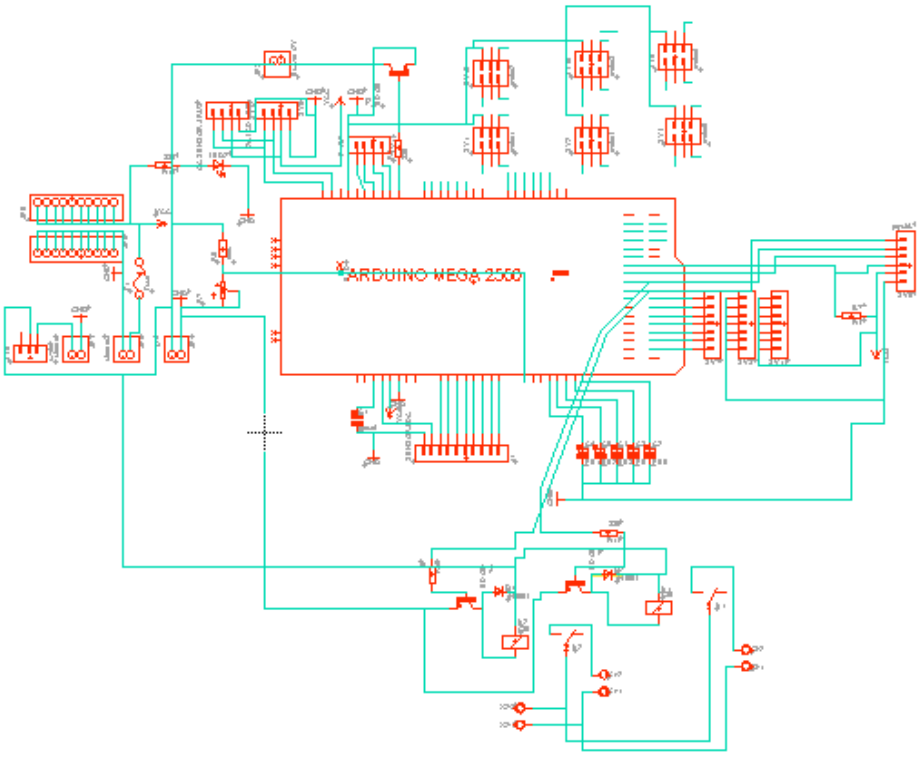


Fig. 3. Mini robot system

3.3. Program System Diagram

The Arduino mega programming used as a manual robotic control center initializes the program and executes the program according to the received logic cues. Fig. 4 is an explanation in the form of a flowchart for the main program used.

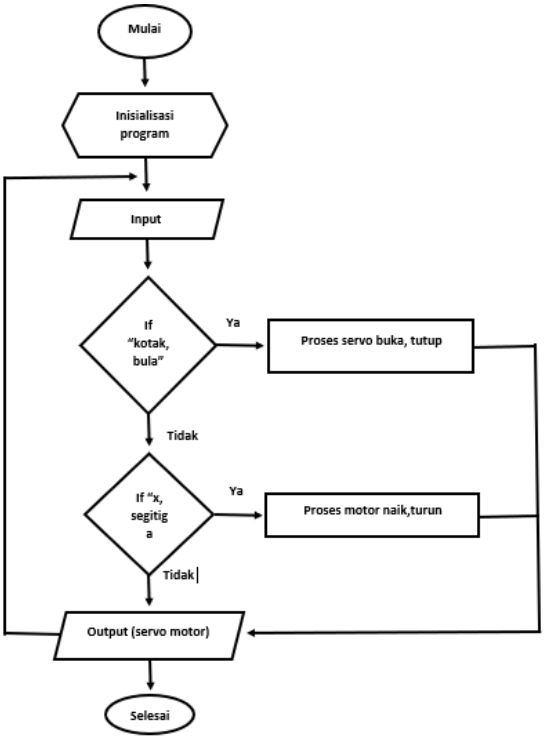


Fig. 4. System diagram

When all the power is turned on, first Arduino as the control controller initializes the program, then the program will be continued here there are several input options that function as a servo and motor grinder, if the feeding box will process the servo, the servo will gripper open, if pressed round then the servo will gripper close, and if pressed X then the motor will go down next if pressed by a triangle then the motor will rise, if not used all then done.

4. Results and Discussion

The testing stage by testing the ball picking method and determining the best position or angle of the robot when taking the ball using a gripper, in this testing process is divided into several parts, namely testing angle, time. So that the gripper can take the ball that is on the ball rack and the ball can be taken all and can shorten the time with an angle of 20 degrees to 180 degrees.

4.1. 20° - 50° Angle Testing

In the first test, the manual robot when taking the blessing ball on a zig with an angle of 20° - 50° can only take one blessing ball using the gripper on the leftmost part of the three grippers on the manual borbot. Here's Fig. 5 Robot when picking up a blessing ball with an angle of 20° - 50°.

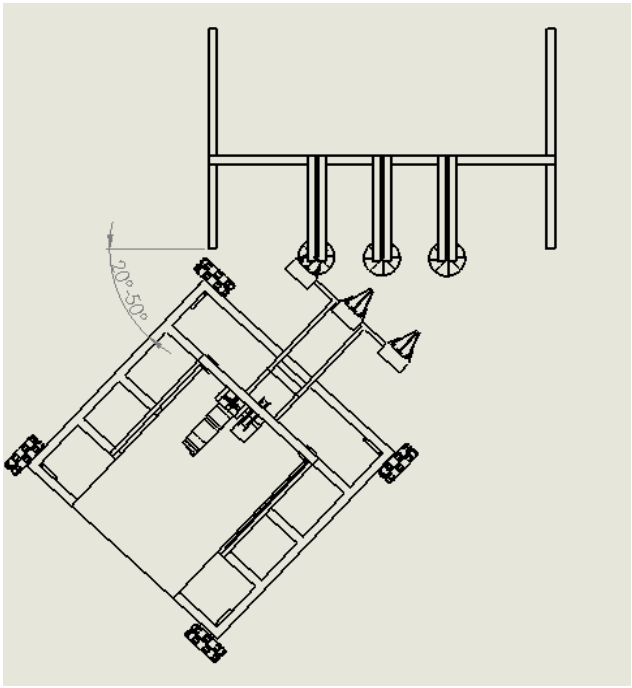


Fig. 5. Shot at an angle of 20° - 50°.

In Table 1 It can be seen that the tests carried out take 10 test data of the throwing of the blessing ball at an angle of 20° - 50°. The following test results can be seen in Table 1.

Table 1. Test results of ball retrieval at an angle of 20° - 50°.

No	Corner (Degree)	Time (Second)	Number of Balls (successful)
1	20˚ - 50˚	21	1 Ball
2	20˚ - 50˚	22	1 Ball
3	20˚ - 50˚	22	1 Ball
4	20˚ - 50˚	23	1 Ball
5	20˚ - 50˚	21	1 Ball
6	20˚ - 50˚	21	1 Ball
7	20˚ - 50˚	22	1 Ball
8	20˚ - 50˚	23	1 Ball
9	20˚ - 50˚	21	1 Ball
10	20˚ - 50˚	21	1 Ball

It can be seen from the test at an angle of 20° - 50° with 10 tests getting the result of 1 blessing ball taking with an average time of 21 seconds.

4.2. Identify the Headings

In the second test of the manual robot when taking the blessing ball on a zig with an angle of 50° - 80° the robot can only take two blessing balls by using the leftmost gripper and the middle gripper section in the manual robot. Here's Fig. 6 of the robot when taking a blessing ball with an angle of 50° - 80°.

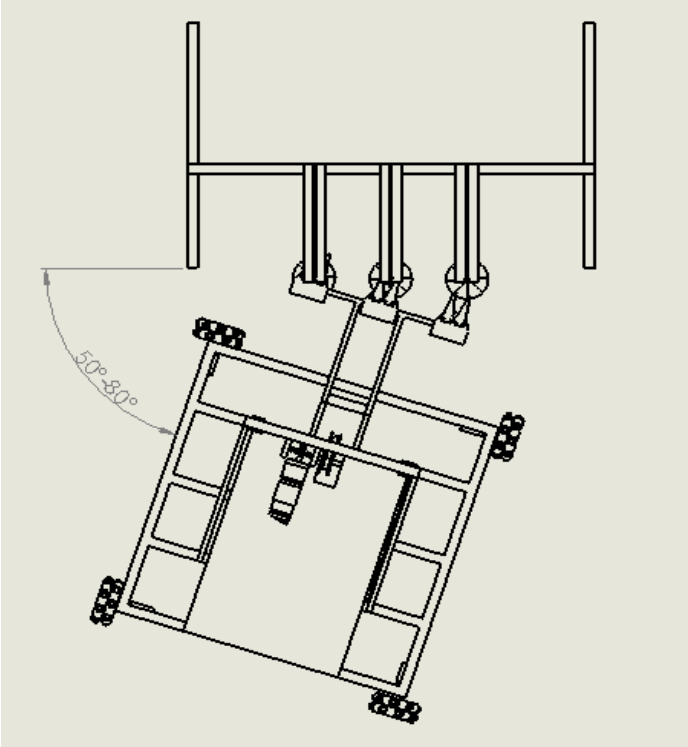


Fig. 6. Shot at an angle of 50° - 80°.

In Table 2 It can be seen that the tests carried out took 10 test data of the throwing of the blessing ball at an angle of 50° - 80°. The following test results can be seen in Table 2.

Table 2. Test results of ball retrieval at an angle of 50° - 80°.

No	Corner (Degree)	Time (Second)	Retrieval (successful)
1	50˚ - 80˚	22	2 Ball
2	50˚ - 80˚	23	2 Ball
3	50˚ - 80˚	22	2 Ball
4	50˚ - 80˚	21	2 Ball
5	50˚ - 80˚	22	2 Ball
6	50˚ - 80˚	21	2 Ball
7	50˚ - 80˚	21	2 Ball
8	50˚ - 80˚	22	3 Ball
9	50˚ - 80˚	21	2 Ball
10	50˚ - 80˚	22	2 Ball

Testing at an angle of 50° - 80° with 10 tests obtained the results of 1 blessing ball taking with an average time of 22 seconds.

4.3. 80° - 110° Angle Testing

In the third test of manual robots when taking the blessing ball on a zig with an angle of 80° - 110° the robot can take all three blessing balls by using all grippers from the left, center, right of all grippers can take the blessing ball. Here's Fig. 7 of the robot when picking up a blessing ball with an angle of 80° - 110°.

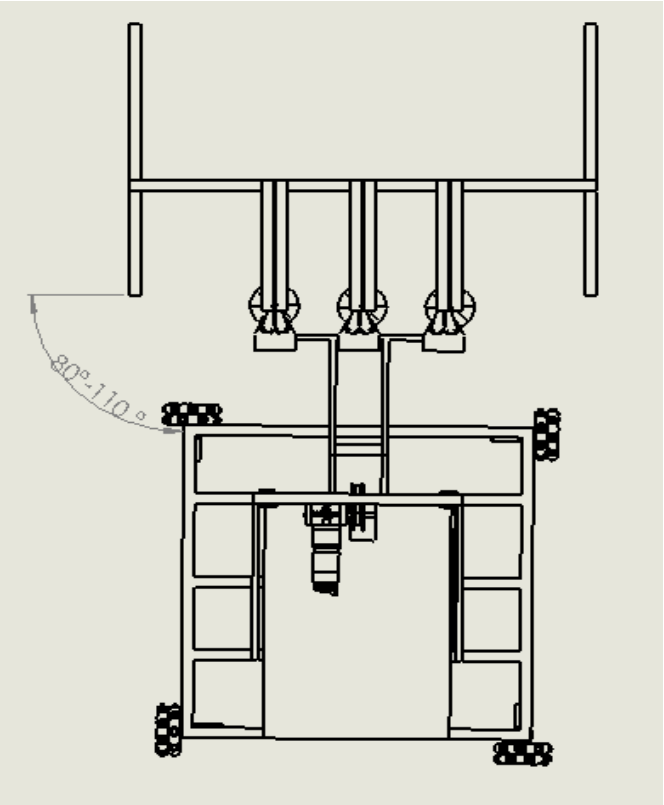


Fig. 7. Shot at an angle of 80° - 110°.

In Table 3 It can be seen that the tests carried out took 10 test data of the throwing of the blessing ball at an angle of 80° - 110°. The following test results can be seen in Table 3.

Table 3. Test results of ball retrieval at an angle of 80° - 110°

No.	Corner (Degree)	Time (Second)	Retrieval
1	80˚ - 110˚.	22	3 Ball
2	80˚ - 110˚	20	3 Ball
3	80˚ - 110˚	22	3 Ball
4	80˚ - 110˚	21	3 Ball
5	80˚ - 110˚	23	3 Ball
6	80˚ - 110˚	21	3 Ball
7	80˚ - 110˚	21	3 Ball
8	80˚ - 110˚	22	3 Ball
9	80˚ - 110˚	21	3 Ball
10	80˚ - 110˚	21	3 Ball

From testing at an angle of 80° - 110° with 10 tests getting the result of 1 blessing ball taking with an average time of 21 seconds.

4.4. 110° - 140° Angle Testing

In the fourth test at an angle of 110° - 140° the manual robot was able to pick up the ball of only two blessing balls by using the middle gripper and the right gripper part of the three grippers. Here's Fig. 8 of the robot when picking up a blessing ball with an angle of 110° - 140°.

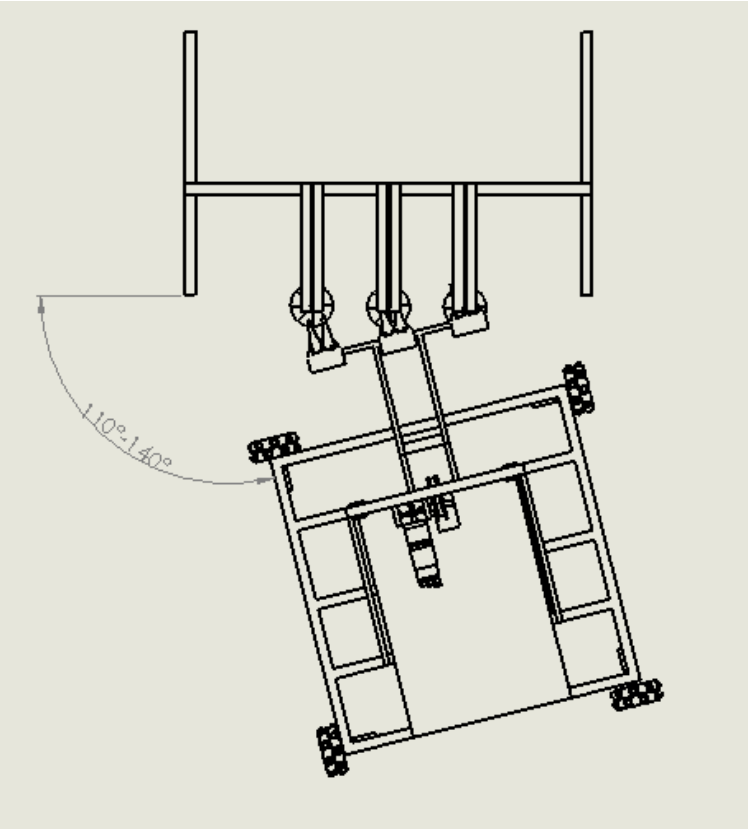


Fig. 8. Shooting at a 110° - 140° angle

In Table 4. It can be seen that the tests carried out take 10 test data of the throwing of the blessing ball with an angle of 110° - 140°. Here are the test results as follows.

Testing at an angle of 110° - 140° with 10 tests obtained the results of 1 blessing ball taking with an average time of 21 seconds.

Table 4. Test results of ball retrieval at an angle of 110° - 140°

No	Corner (Degree)	Time (Second)	Number of Balls (successful)
1	110˚ - 140˚	21	2 Ball
2	110˚ - 140˚	23	2 Ball
3	110˚ - 140˚	22	2 Ball
4	110˚ - 140˚	21	2 Ball
5	110˚ - 140˚	22	2 Ball
6	110˚ - 140˚	23	3 Ball
7	110˚ - 140˚	22	2 Ball
8	110˚ - 140˚	21	2 Ball
9	110˚ - 140˚	21	2 Ball
10	110˚ - 140˚	23	3 Ball

Testing at an angle of 110° - 140° with 10 tests obtained the results of 1 blessing ball taking with an average time of 21 seconds.

4.5. 140° - 170° Angle Testing

In the fifth test with testing at an angle of 140° - 170° the manual robot can take a blessing ball using the right gripper of the gripper on the robot. Here's Fig. 9 of the robot when picking up a blessing ball with an angle of 140° - 170°.

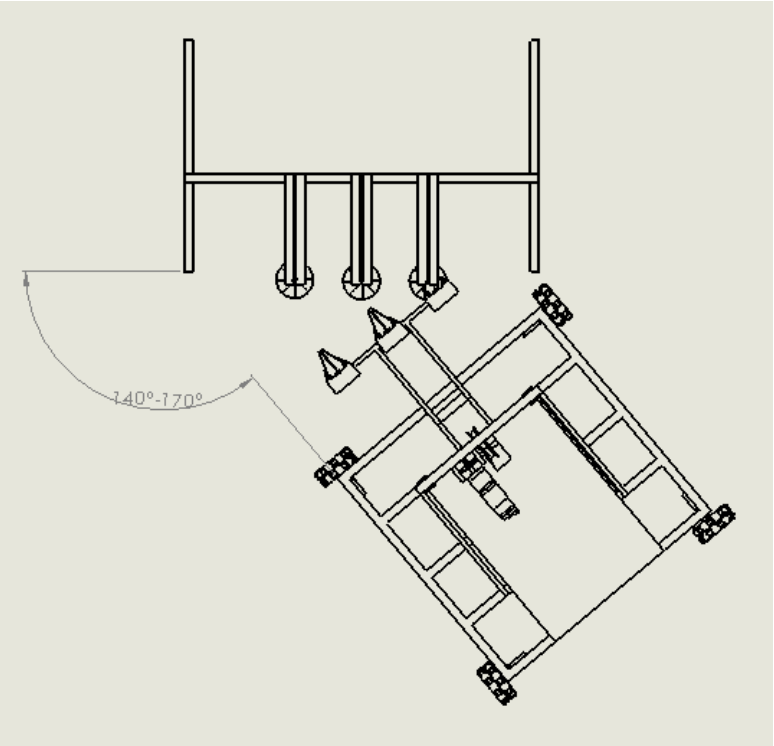


Fig. 9. Shooting at a 140° - 170° angle

In Table 5 It can be seen that the tests carried out take 10 test data of the throwing of the blessing ball at an angle of 140° - 170°. The following test results can be seen in Table 5.

Table 5. Test results of ball retrieval at an angle of 140° - 170°

No	Corner (Degree)	Time (Second)	Number of Balls (successful)
1	140˚ - 170˚	22	1 Ball
2	140˚ - 170˚	22	1 Ball
3	140˚ - 170˚	21	1 Ball
4	140˚ - 170˚	23	2 Ball
5	140˚ - 170˚	22	1 Ball
6	140˚ - 170˚	23	2 Ball
7	140˚ - 170˚	21	1 Ball
8	140˚ - 170˚	22	1 Ball
9	140˚ - 170˚	21	1 Ball
10	140˚ - 170˚	22	1 Ball

Judging from the test at an angle of 140° - 170° with 10 tests getting the result of 1 blessing ball taking with an average time of 22 seconds.

5. Conclusion

Research with this gripper design seeks that robots can pick up balls without the help of human hands which is prohibited in the 2018 KRAI robot competition which only robots can pick up balls without direct human assistance and robots can pick up balls that have been placed on the zig with a gripper or tongs and deliver to the robot automatically. The gripper height for taking the blessing ball can be lowered according to the position of the ball to be taken. Gripper uses 2 levels arranged top and bottom. The upper gripper amounts to 3 pieces and the lower gripper amounts to 3 pieces. In the upper gripper, the gripper distance between one and the other 150 mm adjusts the distance between the ball straps that have been arranged in the zig as far as 150 mm. While the height of the upper and lower grippers is 200 mm. Based on the design results, retrieval with a robot using a gripper can pick up the ball from a zig or ball rack. The mechanical movement on the gripper robot can move open

and close the gripper controlled by a designed electrical system. Testing the position of the best robot by varying the angle of taking in the results in the 5 tests that have been carried out there are experiments that have been declared efficient because they can take 3 balls with a 100% success percentage in an average time of 21 seconds. So, it can be concluded that testing on the taking of the blessing ball using an angle of 80° - 110° is more efficient compared to the angle of 20°-80° and 110°-170°.

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