# Smart Hunting Cage for Predatory Animals and Moving Bait for Zoology Researches

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## ABSTRACT

This paper presented an approach to design and implement a control scheme for hunting cages of predatory animals without hurting for scientific researchers or animals. In this paper, laser detection circuit is applied to detect target entering the cage and send signal to microcontroller to lock the two gates of the cage then send signal to alarm user. The bait is used to lure the target mounted on moving robot using ultrasonic sensor to determine the distance between the target and the bait and made it go in the cage.

**Keywords:** LASER, Microcontroller, and ultrasonic

## القفص الذكي لصيد الحيوانات المفترسة والطعم المتحرك لابحاث علم الحيوان

**محمد احسان صافي**

**الخلاصة**

قدمت هذه الورقة نهجا لتخطيط وتنفيذ مخطط السيطرة لأقفاص صيد الحيوانات المفترسة دون الاضرار بالباحثين العلميين أو الحيوانات. في هذه الورقة،تم تطبيق دائرة كشف ليزرية للكشف عن الهدف عند دخوله للقفص ارسال اشارة للمعالج الدقيق لقفل بابي القفص واطلاق اشارة لانذار المستخدم.الطعم المستخدم لجذب الهدف يعلق على روبوت يستخدم حساس فوق صوتي لحساب المسافة بين الهدف والطعم وجعله يدخل الى القفص.

## INTRODUCTION

The control of Predatory animals is difficult and dangerous job faces the scientists of zoology in addition to the wasted time of keeping an eye on, which maybe takes a day's. Laser detection is a good idea to control the hunting like security and detection of moving by supply the laser beam to varied resistor according to that beam. The ultrasonic is one of the most methods to measure the distance between the sensor and the barer or any subject on straight line with it. All smart systems need a control unit to handle the input and output with mathematics, operations which represented by the microcontroller. The microcontroller is a microprocessor in addition to a defined quantity of RAM, ROM, I/O ports, and a timer all on a single chip [1].

### System Architecture & Operation

The control system consists of two parts the cage doors control and robot movement control which represents the bait, as shown in the illustration figure (1). The cage's door control part performs the two door locks when the bait which represent, by the robot pass through the beam of Laser then alarm user that there is an animal in the cage. The robot movement control part performs retreat robot to the end of the cage when the target become in front of it with space of



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one meter until the bait, cut the laser and access out of the cage, then the cage's door control part will lock the two doors.

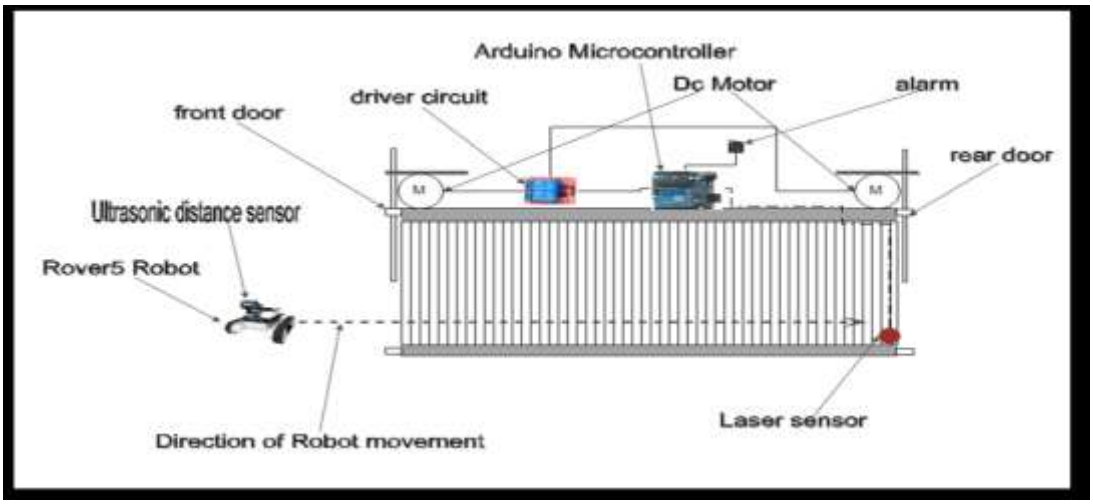


**Figure (1): control system**

**The cage doors control part**

The cage doors control part design composed of Microcontroller, Laser sensor, motors driver circuit and Buzzer, as shown in figure (2). The microcontroller block represented by The Arduino UNO, which is a microcontroller board based on the ATmega328. (It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The UNO differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter [2]. To provide current that motors needed the driver circuit must be used [3], which is a Relay circuit uses signal Logic TTL to control RELAY, which is controlled by OPTO-ISLATE circuit [4], as shown in figure (3).

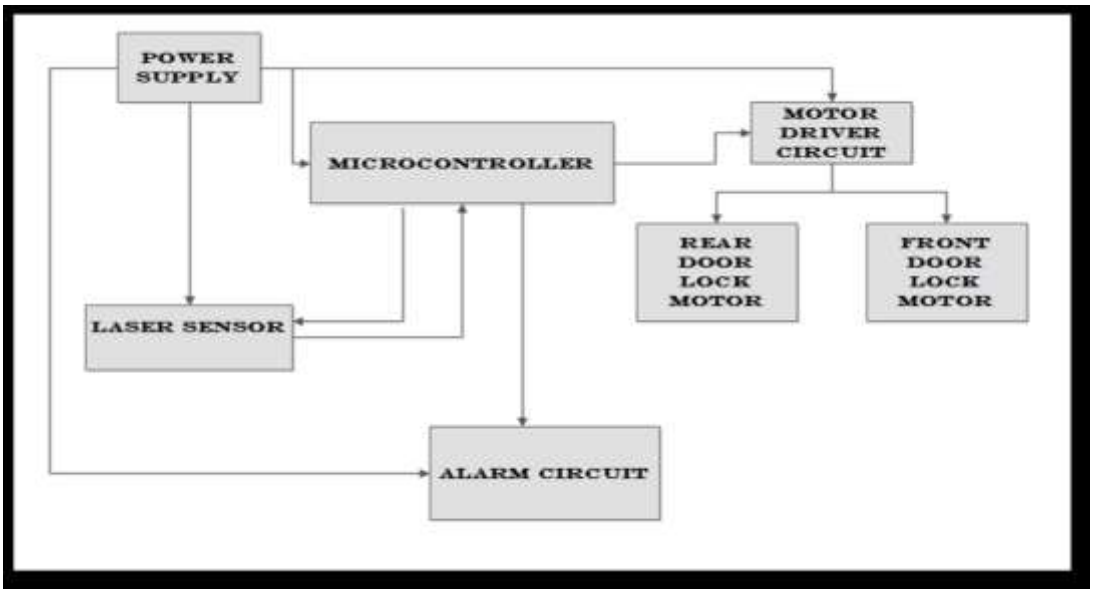


**Figure (2): The cage doors control part**

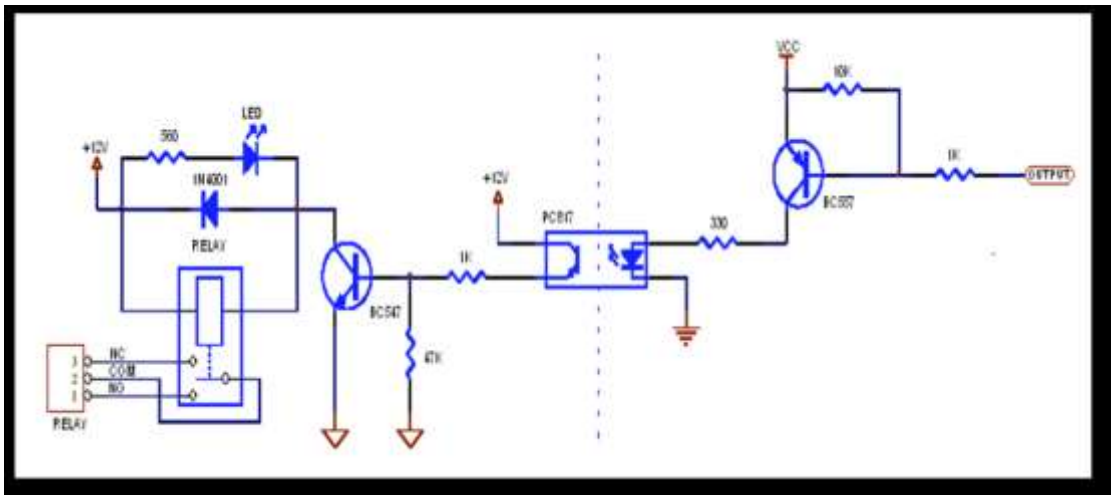


**Figure (3): driver circuit for each motor**

A laser which is at the end of the cage close to the rear door supply of the photo-resistor, when the laser Tripwire cuts the microcontroller send signal to close the doors and the alarm to be on, the practical circuit as shown in figure (4).

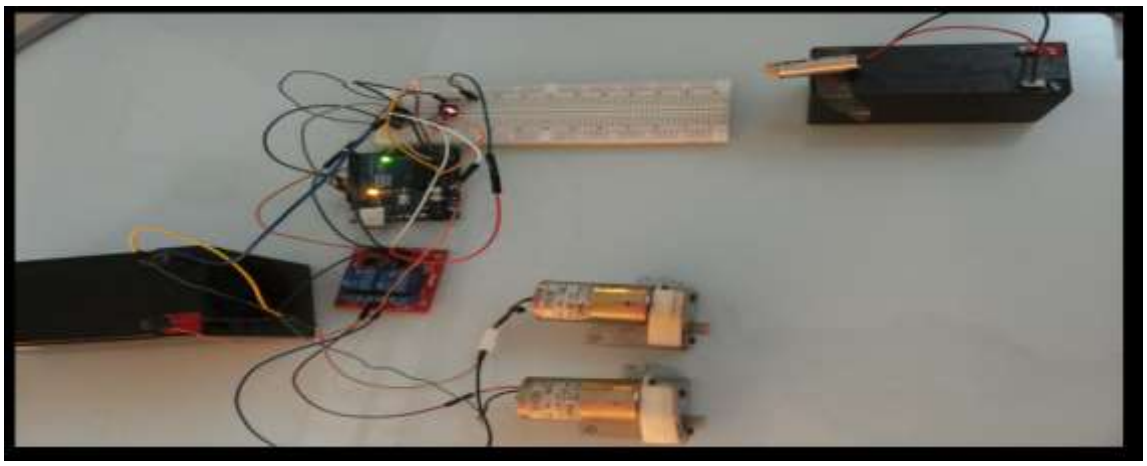

**Figure (4): practical circuit the cage doors control part**

**2.2 The robot movement control**

The bait robot consists of microcontroller, Ultrasonic sensor, motor driver circuit and two DC motors, as shown in figure (5). The microcontroller block represented by The Arduino UNO, which is a microcontroller board based on the ATmega328, as we illustrate before. The driver circuit consists of two H-bridge interfaced with microcontroller used to control DC motors of the robot in its movement to backward or forward to drawing the target inside the cage. The distance adjustment determined by ultrasonic sensor gets the trigger from the microcontroller and gets back the echo, and the distance measured by using the following equation [5] [6]:

Distance = measured time * velocity (340m/s) / 2…….. (1)

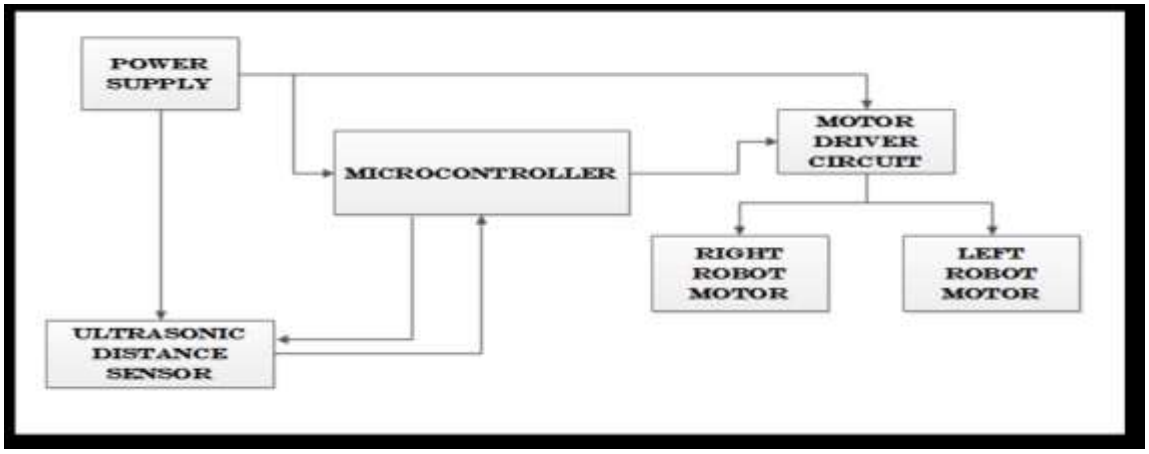


**Figure (5): The bait robot control system**

The ultrasonic sensor that used is module HC - SR04, which is provided (2cm - 400cm) non-contact measurement function, the ranging accuracy can reach to 3mm [6]. The circuit tested using the Proteus simulation program as shown in figure (6).

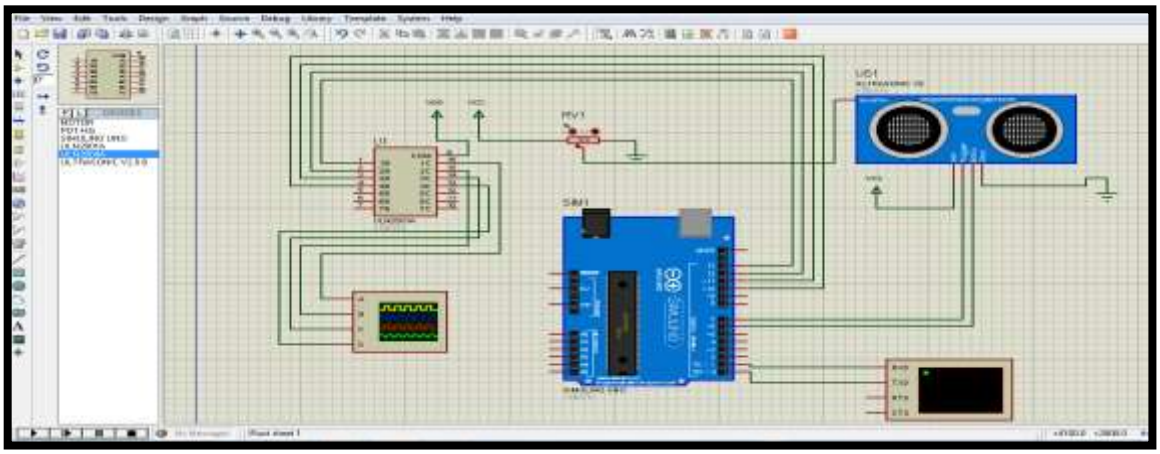

**Figure (6): simulation circuit**

The simulation result of detecting target in the field shown in figure (7), it shows the response of the bait when the target be in front of bait by one meter.


**Figure (7): Detection response**

The output of the circuit that drives the motors is shown in the figure (8).

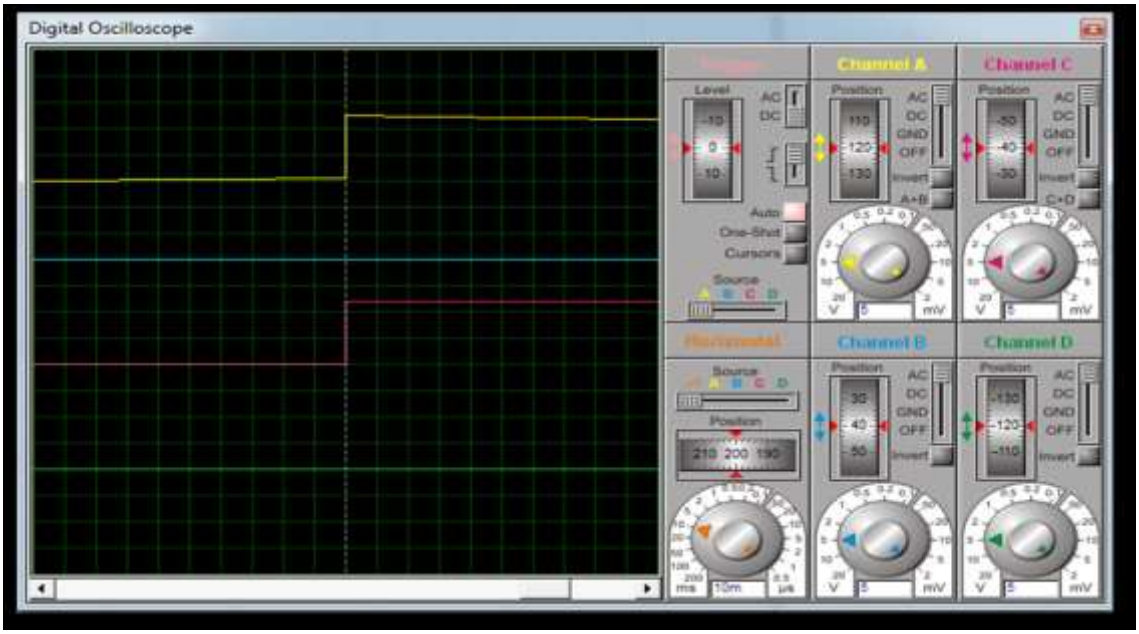


**Figure (8): output power delivered to the motors.**

The mobile robot that is used is Rover 5. This robot consists of four DC motors. Each motor is supplied with gearbox of 87:1 ratio and an optical quadrature encoder that gives 1000 stage change over 3 revolutions of the output shaft [7]. The practical system of the bait robot is shown in figure (9).

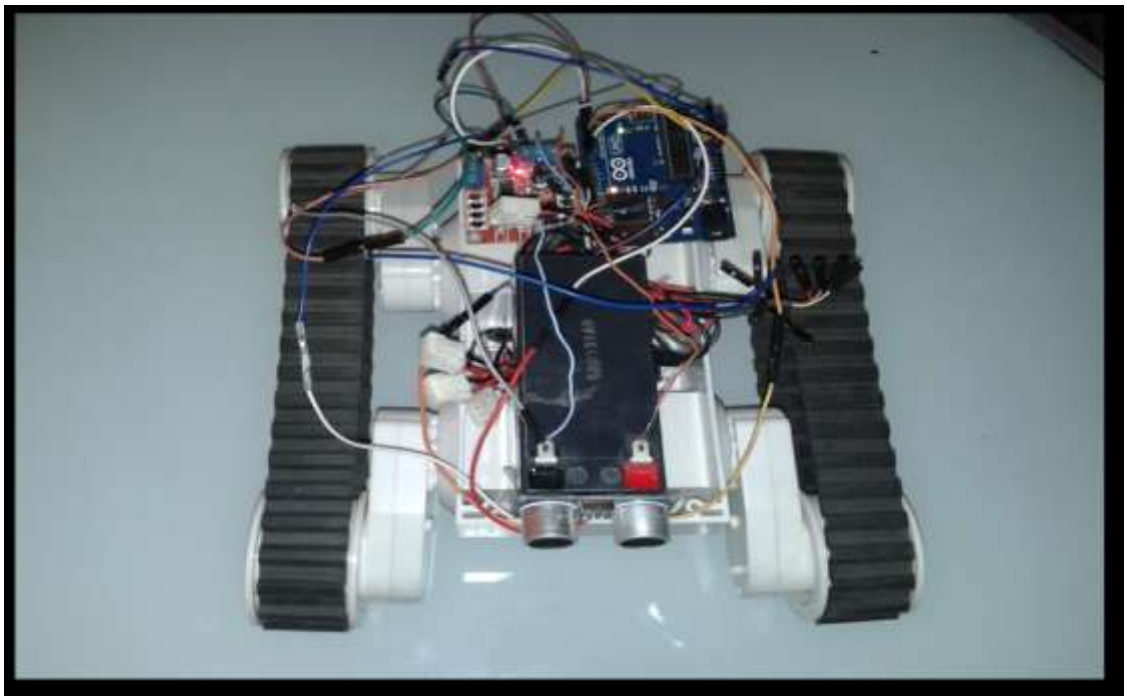

**Figure (9): The practical circuit of bait robot control system**

**Measurement of practical system**

The cages and speeds of baits are differing from animals to another because of differences in the speeds and volumes. The minimum length of the cage (LC) depends on the length of the animal (LA) and secure distance (D) between the bait and the animal using the equation below:

Minimum length of the cage (LC) =Length of animals (LA) + Secure distance (D)….. (2)

Where the security distance is in the system is 1 meter. The minimum height of the cage is equal to the height of the animal. The minimum speed of the bait depends on the top speed of the animal. The table (1) shows some of predatory animal's lengths and speeds and the minimum length of the cage and the minimum speed of the bait [8].

**Table (1): measurements of the minimum length of cages and speed of baits**

| Animal | Length of the animal with the tail | Top Speed of the animal and minimum speed of the bait | Minimum Length of the cage |
|---|---|---|---|
| Lion | 3.2m to 4.3m | 80km/h | 5.3m |
| Tiger | 2.7m to 3.1m | 96.6km/h | 4.1m |
| Wolf | 0.6m to 0.91m | 75km/h | 1.91m |
| Fox | 0.4m to 0.83m | 48km/h | 1.83m |
| Jackal | 0.9m to 1.05m | 32 km/h | 2.05m |
| Leopard | 1m to 1.9m | 45kph | 2.9m |

**Limitation of the system**

The system is limited by the angle of the ultrasonic sensor. The practical sensor that used in the bait is 15degree [6], which is enough to detect the target if it was in front of the detector so the optimal position to the bait is one meter inside the cage to make sure that the target be opposite to the bait. Another approach is to use many of detector minimum 3 sensors to cover the active directions.

The Ultrasonic exhibit good immunity to background noise because the noise reduced as the frequency increases. The reason is that less noise at the higher frequencies is produced in the environment, and the noise that is produced is greatly attenuated as it travels through the air [9]. The ultrasonic sensor that is used in the system is 40 kHz.

**Conclusion and future work**

The control system provides control predatory animals without hurting it and reduces the risk of capturing wild animals and save the effort of surveillance. The system can easily develop, especially because of using the microcontroller.

The system can be adding a camera and send the picture of the hunted animals using GSM and the user can be controlled the cage using the mobile.

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