

# Implementation of Multisensor to Detect Vibration, Sound and Image of Combat Vehicles Use Artificial Neural Networks

Nur Rachman Supadmana Muda<sup>1\*</sup>, Bilqis Faranadila<sup>1</sup>, M.Faisal Fadilah<sup>1</sup>

<sup>1</sup>Poltekad Kodiklatad, Batu Indonesia

**Abstract:-** Multisensors in general used in the military world as system sensing far to aim For detect existence object Good sound , vibration nor *image* around with use wave electromagnetic . With do application computing systematic, will obtained A visual depiction of representation from medium object observed. Implementation Multisensor can utilise principle radiation and reflection wave electromagnetic or wave sound on energy levels and intervals time certain. With do application computing systematic, will obtained a visual depiction of representation from medium object observed. Although modern multisensors have have diverse function, however task his first as detector something object tanks still still is one of from its most important function, because until with moment this still not yet There is none other capable systems detect tanks as quickly and accurately as it does multisensor. Target distance to multisensor can is known with measure transmitter time , ie the time required by the signal multisensor for reach the target and return again to the recipient, for example is recognize tanks with image digital patterns using *Artificial Neural Networks*

**Keywords:-** Multisensor , Tank, Raspberry, ANN.

## I. INTRODUCTION

Multisensors in general used in the military world as system purposeful sensing for detect existence object good *images*, sound, nor vibration around with use wave electromagnetic. Multisensor work with utilise characteristic reflection wave electromagnetic. When wave electromagnetic emitted by *the transmitter* and hit something surface , then wave the will reflected and captured by *the receiver*. If *receiver* accept reflection wave the means there is something objects within range multisensor causes wave electromagnetic reflected. With analyze reflected signal that, reflection signal can determined location and sometimes can also be determined the type. Although received signal relatively weak or small but radio signal the can with easy detected and amplified by multisensor [1]. Besides the usage Multisensor For detect something objects in general Not yet applied in supervise area the arrival of enemy tanks . Along with development over time, usage Multisensor can be one solution for detect and scout the presence of enemy tanks. Implementation multisensor can utilise principle radiation and reflection wave electromagnetic or wave sound on energy levels and intervals time certain. With do application

computing systematic, will obtained a visual depiction of representation from medium object observed. Based on the description has been explained about benefit use multisensor and related studies with implementation multisensor , which can developed in the military world, ie Implementation multisensory for detect vibration, sound and *image of the tank* use *Artificial Neural Networks*. This study expected can make it easier in implementation task soldier in area battle and more know power and crushing the enemy will faced in order to achieve it something task operation in battle.

## II. MATERIALS AND METHODS

### ➤ *Materials*

The tank Leopard 2 is a battle tank main MBT (*Main Battle Tank*) Germany developed by Krauss *Maffei* in the early 1970s and began used in 1979. Leopard 2 replaces Leopard 1 as a battle tank main Army West Germany ( *Bundeswehr* ). The Leopard 2 was first used by the Army Germany in the Kosovo War as well troops Canada and Denmark are incorporated in ISAF in the field Afghan combat . The image of the main battle Tank Leopard as shown in figure 1 [2].



Fig 1. Leopard BattleTank [2]

Development main on this tank , has dome shoot vertical layered steel and more models proceed as well as own dome shoot corner like child arrow with Applique armor . All models are equipped with system controller digital shooting and tracking lasers distance , cannon main 120 mm with stability high , rifle machine coaxial , as well equipment For see and aim in more darkness ( night vision ). proceed . Part the front and sides of the turret are fitted with armor addition shaped steel , which can with easy replaced by a mechanic If shot or , later day , got it replaced with more

armor advanced . Side panels from steel addition This depends and can swung to front , needed If machine will replaced . Mantlet cannon has designed reset , and additional stowage box mounted on the rear and sides of the turret. Part in the turret now installed with a spall liner for increase protection crewman to fragments . System stabilization and control cannon hydraulic replaced with system electric [2].

Telescope additional FERO Z-18 optics moved position at the top mantlet cannon, and sights panoramic PERI-R 17 courtesy commander moved to adjacent behind left room commander. Aim independent commanders were also developed with chanel displayed thermal in a monitor inside room commander . Modified laser distance data processor so Leopard 2 now can attack helicopter with APFSDS-T ammunition , and systems GPS navigation is created with GPS antenna installed behind the turret roof. Additional armor make heavy Leopard 2 fighter becomes 59,500 kg, which is the same very no affects mobility [3]

**Table 1.** Leopard 2 Tank Specifications [2]

Specification	Information
Weapon principal	120 mm Rheinmetall smoothbore gun L/44.
Weapon addition	Weapon 1 x 12.7 mm and 1 x 7.62 mm machine .
Elevation	- 9 to + 20°.
Dome rotation speed	360° in 9 seconds
Dome weight	16 tons.
Shooter's aiming device	RDE EMES 15 with thermal channel and laser range finder
Aiming device	RDE PERI-R17
Like munitions	Heat DM12 cal.38
ATGM	There is
Smoke grenade launcher	2 x 8 smoke grenade launchers
Aiming device	VERO Z-18.
District maximum	68 km/h, reverse 31 km/h
Wading	1,200mm.
Dive	4,000 mm with snorkel.
Stepping	2,500mm.
Upright resistance	1,000mm.
Max incline	31° (60%).
Radius action	On the road 340 km, on terrain 220 km, on average terrain 280 km

Multisensor is something device used For determine position object, direction its movement nor form from something detected object. At first Multisensor used as one of the tool detector enemy moment war. But moment this Multisensor no only used in the field military, but also used on ships fishermen and ships cruise. Multisensor can help man for see areas that don't can reachable by sight man. On ships , Multisensor works for help boat spared from collision to coral, also for give information about existence other ships around, line beaches, and so on. multisensors also help crewman boat moment in circumstances dark (night day) or foggy.

Principle work multisensor, it works same way with principle reflection wave. When wave electromagnetic (signal) is emitted from transmitter (transmitter), wave the will hit something object, then part wave the received by the recipient. After object the detected , object the will displayed on a display for known to the user Multisensor.

Raspberry Pi is an SBC (Single Board Computer) computer that is similar card developed by the Raspberry Pi Foundation in England product. This called Raspberry Pi by its creator that is, Eben Upton. With meaning for trigger teaching knowledge computer base in schools the Raspberry Pi uses a system on a chip (SoC) from Broadcom BCM2835, which has also been including ARMv10 processor , speed 700MHz – 1GHz processor and 4 GPUs, this Raspberry 8GB Raspberry Pi 4 Model B RAM Quad core 64-bit 1.5GHz has 512 MB of RAM , and for store data accordingly computers , laptops usually use Hard disk but this Raspberry Pi only use card normal memory \_ used For Data storage on the cellphone is good based symbian , android. Here is a picture of the Raspberry 8GB Raspberry Pi 4 Model B RAM Quad core 64-bit 1.5GHz, as shown in figure 2.



**Fig 2.** Raspberry 8GB Raspberry Pi 4 Model B RAM Quad core 64-bit 1.5GHz

Raspberry Pi can used for various type need in daily like design get up server,design build a robot, okay whether it's a prototype or autonomos and equipment technology Others, Raspberry Pi can also used worthy computer normal For need office. System operations that the Raspberry Pi uses frequently used is Raspbian PI derivative from system operation Debian. Raspberry pi camera used as a sensor to capture images of the tank. which will then be processed by the Raspberry Pi. Camera Pi or what is usually called pi-camera is a camera device that is integrated with the Raspberry Pi. Camera Pi is connected to the CSI port on the Raspberry Pi board. Installation the pi camera, just connect the camera cable directly to the CSI port, then select enable camera in the raspberry pi configuration. This camera module already has a resolution of 5 MP without autofocus. For its application, Raspberry has included a library which can then be developed into a program, as shown in figure 3.



**Fig 3.** Camera Pi

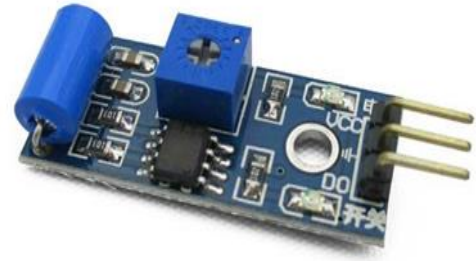
Sound analog sensor For detect voice as input, is used sound sensor mic in manufacture tool measuring level noise voice, as shown in figure 4. Sound sensor.



**Fig 4.** Sound Sensor [4]

Sound sensor is a sensor that way it works change magnitude voice become magnitude electricity , and on the market Already so wide its use. Components included in the sound sensor namely electric condenser microphone or condenser mic. ECM or Electric Condenser Microphone or also called a condenser mic is a microphone made from plate thin conductors form A capacitors that can fickle mark its capacity in accordance with vibration votes received.

Vibration Sensor is something device or changing device magnitude physical form vibration become magnitude electric that can form voltage nor current. In general vibration This changed become current Because consideration that distance between sensors on the device This with controller No very close , there possibility the distance Far. When vibration changed become current , then current produced by the sensor with received current with controller will same it. This matter naturally will different if vibration changed become voltage . The voltage produced by the sensor will be no the same with received voltage controller as consequence from exists losses as shown in figure 5. Vibration Sensor.



**Fig 5.** Vibration Sensor

➤ *Methods*

Image is information that is general stored in form mapping of bits or often known with bitmaps. Every bit makes up One point known information \_ with pixels . One pixel is One point composed image \_from One or some bits of information . Unit from pixels usually stated with x position, y position and value from pixels ( color or gray ). In One field image , completely consists from pixels . Therefore , the file that saves image normal saved with BMP name . For reduce size from a file, usually an image file compressed with use technique certain , for example famous ones namely JPEG or GIF. Image is representation from two dimensions For form physique real from three dimensions . Deep image its embodiment can miscellaneous , start from picture colored ones that move on the plane television . Image can also said to be A images , photos shown or other forms that provide visual representation of A object or view. On processing a digital image picture 2- dimensional array of numbers , each of which the line is representation pixels in the image every the line . Minimum value pixels = 0 ( black ) , maximum = 225 ( white ) . Computer need memory more Lots for this data an average of 3 times the data storage.

Transformation process from form three dimensions to form two dimensions For produce image will influenced by various things contributing factors appearance image something object no the same exactly with form physique in fact. Factors the is effect degradation or decline quality that can be form range contrast too much thing narrow or too width, distortion fuzziness (blur), blurriness consequence object moving images (motion blur), noise or interference caused by interference equipment maker image form equipment electronic . Due to processing digital imaging is carried out with digital computer then image that will processed moreover formerly transformed to in form massive discrete from mark level gray in spots element image . In image processing there is an acquisition process Digital imaging is a very process determine quality results of the digital imaging process that will be obtained . Order the acquisition process digital images can happen required three component the main thing is to do it fulfilled that is source light, object or thing that will observed , and sensors in the form of camera That Alone . The process that is the light hits surface object reflected to all direction . Reflection light This part captured by sensitive sensors light on the camera . Intensity light received by the representation sensor condition object. So that digital image obtained is information about formed object from reflection light or reflection on the surface object.

Pattern is a defined and able entity defined through its characteristics. Characteristics that are used to differentiate one pattern from other patterns. Pattern recognition aims to determine categories of pattern groups based on the characteristics of the pattern. In other words, recognition patterns differentiate one object from another. Something that a pattern recognition system does includes:

- Data acquisition process through a number tool sensing or sensors.
- Arrange form data representation .
- Carry out data analysis and classification processes.

Digital Image Patterns are divided into 2 system, namely There is images that are analog and existing digital image. An analog image is characteristic image continuous like image on a television monitor , photo X rays , CT scan results etc. Meanwhile , digital images are image that can be processed by computer. A digital images can represent by a matrix consisting from M columns N rows , where intersection between columns and rows called pixels (pixel = picture element), ie element smallest from A image. Pixel have two parameters, viz coordinates and intensity or color . The value contained in the coordinates ( x , y ) is f ( x , y ), namely big intensity or color from pixels in dots it. By because that , a digital images can written in form matrix following, as shown in figure 6. Matrix digital image [5].

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \dots & f(0,M-1) \\ f(1,0) & \dots & \dots & f(1,M-1) \\ \dots & \dots & \dots & \dots \\ f(N-1,0) & f(N-1,1) & \dots & f(N-1,M-1) \end{bmatrix}$$

Fig 6. Matrix digital image

Based on description that , in fact mathematical digital images can written down as function intensity f ( x , y ), where the prices of x ( row ) and y ( column ) are coordinate position and f(x,y) are mark function on each point (x,y) which states big intensity image or level grey or color from pixels in dots the . In the digitization process (sampling and quantity ) is obtained big row M and column N to image form matrix M x N and quantity level grey pixel G [5]. The simple definition of image processing is the manipulation and analysis of image information with a computer. The image information in question is a two-dimensional immersive visual image. All operations To enhance, analyze or change images are called image processing. The basic design of image processing is taken from the ability of the human sense of sight and then connected to the ability of the human brain. Historically, image processing has been applied in various forms, with a considerable degree of success. Like various other branches of science, image processing also involves various things that are combined with other branches of science. Such as optics, electronics, mathematics, photography, and computer technology.

Various fields have utilized many applications of image processing in the commercial, industrial and medical fields. Even the military sector has taken advantage of developments in the world of digital image processing.

### III. RESULT AND DISCUSION

In general, objective from image processing is transform or analyze something picture so that information new about picture made more clear . There are many way that can be applied in something operation image processing. In accordance with the development of computers themselves, image processing has two main objectives, namely as follows:

- Improve image quality, where the resulting image can display information clearly. This means that humans act as information processors (human perception).
- Extracting prominent characteristic information in an image, where the result is image information where humans obtain characteristic information from the image numerically or in other words the computer (machine) interprets the information in the image through data quantities that can be clearly differentiated ( in the form of a numerical quantity).

In development more Next , image processing and computer vision are used as replacement eye man with device input image capture like cameras and scanners are used as eyes and machines computer made as processing brain information So that appear a number of fraction field to be important in Computer vision includes : pattern recognition (recognition pattern), biometric (recognition identification man based on characteristic features biology that appears on the human body), content based image and video retrieval (getting return image or videos with information certain), video editing and others.

#### ➤ Grayscale

The grayscale image type is an image type where the image only has its own color gradations from black to white. In the greyscale image type there is no influence of other colors such as red or green. For do change something full color image becomes something grayscale images or scale grey , there is a number of general method \_ used . The simplest method that is with take third mark element color basic , which is then averaged. This method can seen in the equation following in figure 7. Grayscale formula.

$$grayscale = \frac{R+G+B}{3}$$

Fig 7. Grayscale Formula

Information :

- R: Element color red on the RGB color base
- M: Element color green on an RGB color basis
- B: Element color blue on the RGB color base

From Eq the so will obtained something mark between 0 -255, 0 for black and 255 for white , as shown in table 1. Grayscale.

**Table 1.** Grayscale

R = 255 G = 255 B = 255	R = 120 G = 255 B = 255	R = 100 G = 0 B = 200
R = 0 G = 0 B = 0	R = 255 G = 255 B = 255	R = 100 G = 120 B = 51
R = 55 G = 52 B = 25	R = 120 G = 255 B = 210	R = 0 G = 0 B = 180

Thresholding is a process for separate foreground with background from something image . The thresholding process is carried out with method see difference intensity color from an image. The input for the thresholding process is a grayscale image. The output of this process is a binary image, which is black pixels represents the foreground and white pixels represents the background or on the contrary . Binary images are an image whose pixels are only own two mark intensity. Frequent intensity values used namely 0 for black pixels and 255 for white pixels.

*Thresholding* process use a parameter is called with intensity threshold. Each pixel of the image is compared with threshold intensity. If more pixel intensity tall from threshold intensity then the pixel is set become white, on the other hand if more pixel intensity low then the pixel is set become black.

Skew *angle detection* is a counting process degrees slope from something image document. The method will used for the skew *angle detection process* is method analysis linear regression . The formula used in the method analysis linear regression is as following in figure 8.

$$B = \frac{n \sum_{i=1}^n x_i y_i - (\sum_{i=1}^n x_i)(\sum_{i=1}^n y_i)}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2}$$

**Fig 8.** Skew Angle Detection Formula

Information :

- $x_i$ : ith x coordinate of the black pixel
- $y_i$ : ith y coordinate of the black pixel
- $n$  : the number of black pixels in a line of text
- $B$ : slope of a line of text

$$\theta = \tan^{-1}(B)$$

Information :

- $B$  : from something line text , value  $B$  taken from formula previously
- $\theta$ : degree of inclination something line text

Characteristic point extraction is a feature extraction method used to extract or retrieve the characteristics or features found in an object in a digital image using the method of counting the number of points or pixels found in each check, where the check is carried out in various directions tracing the check. Cartesian coordinates of the digital image being analyzed, namely vertical, horizontal, right diagonal and left diagonal.

Artificial neural networks are an information processing paradigm inspired by the biological system of nerve cells, similar to information processing in the brain. The fundamental element of this paradigm is the new structure of the information processing system. Artificial neural networks like humans learn from examples. Artificial neural networks are created to solve certain problems such as pattern recognition or classification due to the learning process.

Computing network nerves imitation give advantages that are

- Characteristic adaptive to changes in influencing parameters characteristics system so that in the process of learning and implementing task based on the data provided moment training.
- Own immunity or tolerant to meaning error \_ network nerves imitation still functioning although There is incompleteness of the data entered and have ability fill in part Insufficient input \_ complete like that appearance so that still obtained complete output , \_
- System can trained with give decisions that provide the training set previously For achieve certain targets so that system capable build and deliver answer in accordance with information received in the training process,
- Have structure parallel and distributed which means computing can done by more from One element working processor in a way simultaneous .
- Capable classify pattern input and pattern output through an adjustment process , which is where pattern output connected with input provided by the system ,
- Reduce noise so that produced more output clean ,
- Can used in the optimization process solution something problem,
- Can used in the control process input order system obtain desired response

Network nerves imitation formed as generalization of mathematical models from network nerves biology with assumption as following.

- Processing information happens to many element simple (neurons).
- Signal sent between neurons through liaison.
- Liaison between neurons have the weight will be strengthen or weaken signal.
- For determine output (output), each neuron uses function activation imposed on addition input (input) received, the amount this output furthermore compared to with something limit threshold.

Architecture Network Nerves Imitation, structure network generally consists from a number of group of neurons called layers ( *layers* ). Layers will connected with rule particular form \_ architecture base network as following.

- Single Layer Network (*Single Layer Network* ). On the network here , a bunch neuron *inputs* are connected direct with bunch the output . Signal flow one way from layer . input until layer output . Every node connected with node others are there above and below it , but No with nodes that are on the same layer . Incoming model category This including *Adaline, Hopfield, Perceptron, LVQ,* and

others. Figure 9 is example architecture network screen single within input units

- $(x_1, x_2, \dots, x_i, \dots, x_n)$  and  $m$  output units  $(y_1, y_2, \dots, y_k, \dots, y_m)$  .

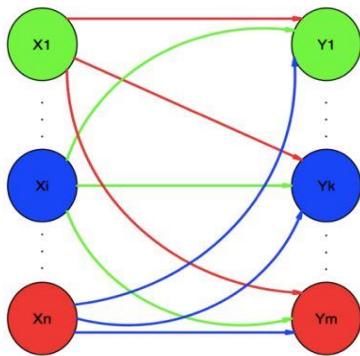


Fig 9. Single Layer Network[9]

- Multiple Layer Network ( Multiple Layer Network ) Network This is expansion from network layer single . In network In addition to the input and output units , there are other units ( often called layer hidden). In Figure 10. multi layer network is example network screen plural within pieces input unit  $(x_1, x_2, \dots, x_i, \dots, x_n)$ , a hidden screen consisting of  $p$  units  $(z_1, \dots, z_j, \dots, z_p)$  and  $m$  fruit output units  $(y_1, y_2, \dots, y_k, \dots, y_m)$

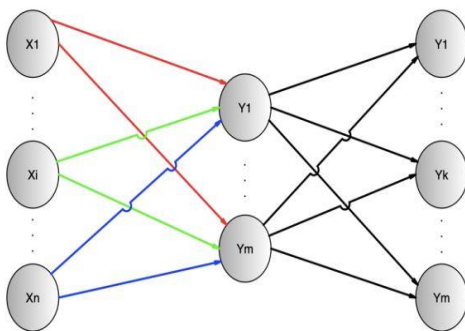


Fig 10. Multi Layer Network[9]

From the results training and testing network nerve perceptron imitation can recognize pattern with an average of 75.25% with percentage Lowest namely 50.75% and percentage highest namely 92.65%. With sufficient percentage \_ Good the system \_ can used For recognize image object simple .

➤ Block Diagrams

The block diagram includes how the tool being made works, then the characteristics of the components used. The entire multisensor detector tank object system can be seen in Figure 11. Block Diagram of multisensor System

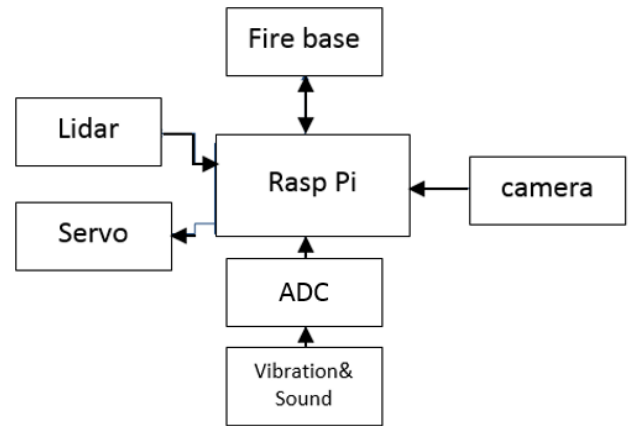


Fig 11. Block Diagram of Multisensor System

In figure 11, it is explained about method work application introduction tank object with utilise technology network nerves artificial. The target that will be captured by the camera form tank armored vehicle. The camera used is IP camera. Camera will catch generating object vibration, sound and image Then will be sent to your laptop or PC(personal computer). This matter using Raspberry Pi 3 B for processing . On this mini PC has there is application network nerves imitation. Application this furthermore will chop image and matching with existing training data There is in databases. Then continued with breaks down sound and vibration data from detected object. If results detection have the same characteristics in the database then results will detected as Leopard 2 tank object this process will Keep going repeated until stopped, then the results data identification the will sent to application visualization.

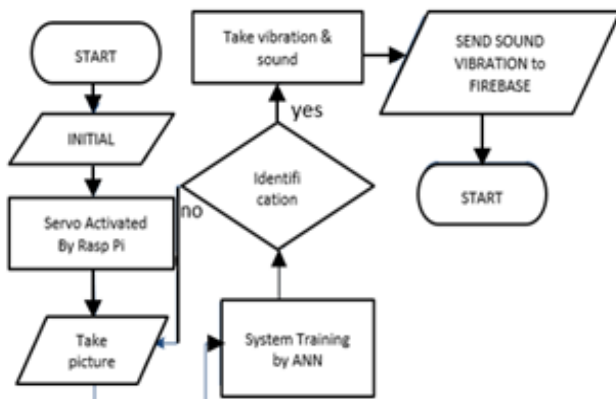
➤ Ways of working Tool

The working principle of tank object recognition is:

- Identification started moment running raspberries.
- Raspberries start initialize servo on.
- Raspberries will instruct camera For capture data in the form of tank image .
- The data file will broken down per Frame
- Frames the will processed Again based on existing characteristics \_
- Processed data will trained with method Matching image template or data that has been set as a database.
- If Still there is error then the data will return separated until No there is error
- Tanks will recognized if No There is error .
- Then retrieves converted sound and vibration data \_ from ADC to SPI using MCP 3008.
- Then raspberries will send voice and image data the to firebase.

➤ *Flow diagram System Multisensor*

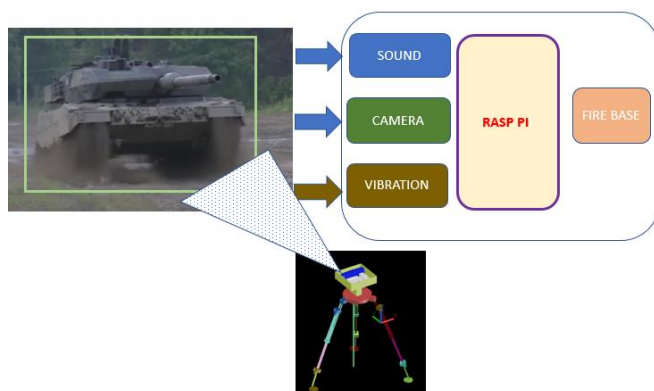
Multysensor system flow diagram as shown in figure 12.



**Fig 12** Diagram Flow of System Multisensor

➤ *Multisensor system work, the overall system works as shown in figure 13. use of multisensors.*

- Initial inputs and outputs.
- Raspberry start light up for take picture object in the form of tanks
- Multisensor detect exists object around the Multisensor sensor coverage area , if object the is a leopard 2 tank.
- Camera take picture object .
- From the picture the processed with using ANN for do matching picture with *training data*
- If object detected as a tank then will carry on to process next , if No so Multisensor will return take picture object .
- After object detected as a Leopard 2 tank then Multisensor start take sound , and vibration of the tank.
- Then the data will sent to *Firestore* to use processed in Android.



**Fig 13.** Use of Multisensors to detect Combat Vehicle

**IV. CONCLUSION**

In general, from this research it can be concluded that sound sensors, vibration sensors and camera sensors through image processing can work optimally to detect combat vehicle because using artificial neural networks are able to assess objects accurately and quickly up to an error value of 0% from the combination of the three sensors.

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