FORM 2
THE PATENTS
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COMPLETE SPECIFICATION
(Section 10)

Real-Time Person Detection and Surveillance System

Applicant(s)

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COMPLETE SPECIFICATION

The following specification particularly describes the invention and the manner in which it is to be performed

1. FIELD OF THE INVENTION:

This invention relates to the field of the **Internet Of Things (IoT)**, **Machine Learning, Hardware System** and **Cybersecurity**. It's a modern approach to building an efficient surveillance system in areas difficult to monitor by humans. It is used for remote surveillance using cameras having specialized features like image capture, compression, and wireless transmission.. The system uses **Wireless Technology** and with an amalgamation of Machine Learning and Cybersecurity to make the system as secure and efficient as possible. This invention aims to bridge the gap in traditional monitoring and surveillance by providing a solution for real-time surveillance in tough environments.

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2. OBJECT OF INVENTION:

The primary purpose of the invention is to provide a surveillance and monitoring system that overcomes the limitations of traditional surveillance methods, particularly in remote or difficult-to-reach areas. As India's diverse and challenging terrains, especially areas near an International border are characterized by unstable and dense environments where human surveillance is difficult, this system ensures real-time capture, encoding, encryption, and wireless transmission of images from these remote or inaccessible areas to a central base station, allowing for real-time monitoring and recording of events. In areas where conventional surveillance setups are not possible, this system has to be such that it relies not only in ordinary conditions but also is not dependent on the conventional wireless transmission technologies, like the Wi-Fi or Cellular Technology.

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3. BACKGROUND OF THE INVENTION:

(a) Monitoring of activity in rural or remote locations such as deserts, large forests, mountainous regions and tundra is typically difficult and expensive, requiring a large number of personal and expensive equipment such as helicopters, drones and global communications such as satellites. One drawback of such systems is that they require high speed data networks and video feeds which are typically not available in remote areas, thereby requiring installation, or consume large amounts of expensive satellite communications. In order to address the above and other drawbacks, this system acts as a trespass detection system for notifying a recipient of a possible trespass at a remote location.

(b) Many sites across the country require security protection – including remote, isolated sites where implementing traditional security solutions is difficult. Remote locations are left unguarded more often due to the isolated nature of the location; there may be less people around in the vicinity to witness and alert authorities to the crime being committed if there is no security present on-site. Remote locations require a security solution that stays operational in even the most outlying locations. Harsh weather can also cause power grids to fail which then in turn affects any security units dependent on that power. What is needed is a proactive security solution that can thrive under any weather conditions, consuming as little power as possible.

The present invention aims to overcome the drawbacks of the disclosed invention.

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4. BRIEF DESCRIPTION OF THE DRAWINGS:

Figure 1 provides the Hardware System diagram (OR functional diagram OR Framework) of the invention.
This figure describes the Hardware Modules on both Transmitter and Receiver Boards respectively.

Figure 2 provides the Transmitter Side Software System Diagram.
This figure describes in detail the Data flow through the transmitter side board to the transmission medium.

Figure 3 provides the Receiver Side Software System Diagram.
This figure describes in detail the Data flow on the receiver side, in order to generate the final received output on the screen.

Figure 4 provides the infographic of the Transmitter Side board.
This figure represents the visual look of the Transmitter side board.

Figure 5 provides the infographic of the Receiver Side board.
This figure represents the visual look of the Transmitter side board.

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5. DETAILED DESCRIPTION OF THE DRAWINGS:

Figure 1: Hardware Diagram

101 : Video Camera Module : Capable of capturing images and videos.

102 : Processor Module : Capable of running Machine Learning processes effectively.

103 : Image Processing Module : Capable of Compressing, Encoding and Encryption of an image.

104 : Wireless Transmitter Module : Capable of Transmitting text information wirelessly over High Distances using Low Power.

105 : Wireless Receiver Module : Capable of wirelessly Receiving the transmitted text information.

106 : Text Processing Module : Capable of Decrypting, Decoding and converting Text Information to an image.

107 : Image Enhancement Module : Capable of running Machine Learning processes to perform image enhancement, to increase resolution of an image.

108 : Display Screen : Capable of displaying high quality images.

109 : Cloud Database : Capable of Storing Images, Programs, Text, processes as well as other information.

Figure 2 : Transmitter Side Software System Diagram

201 : Start : Starting the transmitter Side Board.

202 : Video Recorder : Recording Live Video and Continuously feeding it to 203.

203 : Person Detection : Detecting the presence of a person in the Live video Feed.

204 : Person Detected? : Checks whether 203 has detected the presence of a person or not.

205 : Image Capturing : Capturing Image of the frame where Person has been detected.

206 : Image Compression : Compressing the image output obtained from 205. Minimizing the image size without degrading image quality below a threshold.

207 : Captured and Compressed Image : The final image output obtained from 206.

208 : Image Encoding : Converting binary data of 207 into a text string composed of ASCII characters.

209 : Text Encryption : Encrypting the text output of 208.

210 : Encoded and Encrypted Text Information : The encrypted text obtained from 209.

211 : Wireless Transmission : Transmitting Encrypted Text Information obtained from 210.

212 : Transmitted Information : Information transmitted through 211.

Figure 3 : Receiver Side Software System Diagram

301 : Received Information : Information received from 212.

302 : Wireless Receiver : Receives the Transmitted Information wirelessly.

303 : Decryption : Decrypt the Information received as 212.

304 : Encoded Image Information : Text Output obtained from 303.

305 : Decoder : Converts 304 to image output.

306 : Image Enhancer : Enhances the image obtained from 305 and creates a copy of the same.

307 : Enhanced Image : The image output obtained from 306.

308 : Screen : 307 is displayed on the screen.

309 : Copy of Enhanced Image : Copy of the image output obtained from 306.

310 : Database Updation : Updating the Cloud Database by adding 309 in the existing storage.

Figure 4 : System Infographic Diagram (Transmitter Side)

Figure 4 contains the infographic related to the placement of the modules on the general PCB board on the Transmitter side. The modules include the Video Camera, Processor Module, Image Processing Module, Transmitter Module, Antenna, Battery and Solar Panel, for the power supply.

Figure 5 : System Infographic Diagram (Receiver Side)

Figure 5 contains the infographic related to the placement of the modules on the general PCB board on the Receiver Side. The modules include Antenna, Wireless Receiver Module, Text Processing Module, Image Enhancement Module, Display screen, battery and a port for data transfer.

6. DESCRIPTION OF THE INVENTION:

The proposed system is an amalgamation of Hardware components as well as software processes, which aim to work in tandem.

There are two components to the Hardware System- **Tx-SAK Board** and **Rx-SAK Board,** one each for the Transmitter and the Receiver side respectively**.** Each of these boards is a group of components embedded together on a single PCB to perform the required functions. The Tx-SAK and Rx-SAK differ on the basis of Hardware Components as well as Software processes.

On the Tx-SAK Board, a High Resolution video camera is embedded, which records video and continuously feeds it to the Processing module, which has a pre-installed Person detection process. This process aims to click the picture of that particular frame of the live video stream, in which the presence of a person has been detected. If the person is not detected, then the process constantly waits for a person's presence and forms a closed loop until the presence is detected. As and when the detection occurs, an image is clicked and sent for further actions to the Image processing module. The image processing module has three important functions: Compression, Encoding and Encryption. The image received is firstly compressed, i.e. the image size is minimized with the aim to not degrade the image quality below a certain threshold. The image is then encoded into an ASCII text string, in which the binary data of each image pixel is converted to an ASCII string and all the individual strings are concatenated to form a single text. This obtained text is then encrypted, so as to make it more secure to threats over the span of its transmission. This encrypted text data is then fed into a wireless transmitter, which has capabilities of sending text data over high distances, but by using very low power. This is beneficial for remote areas, where power consumption must be rationed, so as to sustain the battery life of the device for a long time. The transmitter then sends the data wirelessly to the receiver, placed kilometers away from the transmitter.

On the Rx-SAK Board, the received text information is obtained through the wireless receiver. The received text data is sent to the Text processing module, which has two functions: Decryption and Decoding. As it receives encrypted data, the first step on the Rx-SAK board is to decrypt the text so as to obtain the encoded image information. After the decryption, the image information is decoded, wherein the ASCII text is divided into groups, and then each group is converted back into a binary

representation. Combining these binary representations reconstructs the original image. The original image is then fed into the Enhancement Module, which contains a Machine Learning process to enhance the quality of the received Image. The enhanced image is then displayed on the screen attached to the board. This module also creates a copy of the same image, which is added into the cloud database, so as to keep a record of intruder activity for the future.

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7. SUMMARY OF INVENTION

The proposed remote surveillance system helps in effective monitoring of areas that are difficult to reach by human surveillance methods, such as Drones, Helicopters, etc. This system employs a stationary camera setup having a person detection module attached. The person detection module captures, compresses and encodes images of detected individuals into text-based encoded data. The data is then encrypted, adding an extra security layer. The use of high range, low power wireless technology gives a seamless transmission of the encrypted and encoded data to a receiver station, overcoming the geographical barriers in remote or challenging terrains.

At the base station, after the data is received, the encrypted data is securely decrypted and processed through a dedicated decoding block. This process reconstructs the compressed images, and are passed through an image enhancer for improved quality and the resulting images are then stored in a database. The objective lies in the process of capturing, transmitting, and reconstructing images, allowing for real-time surveillance in areas traditionally difficult to monitor.

CLAIMS

We Claim,

1. The **Real-Time Person Detection and Surveillance system,** comprising of:
   (a) A Transmitter Side Tx-SAK Board;
   (b) A Receiver side Tx-SAK Board;

   Wherein the transmitter side is the location from where the image is to be captured and information is to be sent;

   Wherein the receiver side is the location where the transmitted information is to be received and the image is to be regenerated.

2. The Transmitter Side Tx-SAK Board of claim 1, the system comprising of:
   (a) Video Camera Module, capable of capturing high quality live video, even at night;
   (b) Processor Module, capable of Person detection;
   (c) Image Processing Module, capable of image Compression, image Encoding and text Encryption;
   (d) Transmitter Module, capable of transmitting text data using low power over high distances.

3. The Person Detection process present in the Processing Module of Claim 2, which detects the presence of a person in the video feed, and captures an image.

4. The Image Processing Module of Claim 2, comprising of:
   (a) Image Compression process, capable of minimizing the size of image without degrading image quality below a certain threshold;
   (b) Image Encoding process, capable of converting an image into a string of ASCII characters;
   (c) Encryption process, capable of encrypting text information;

   Wherein the encoded text information is the text information formed due to encoding the compressed image obtained from Image Compression process;

   Wherein the encoded information is then encrypted using the encryption process of claim 4, to form an encoded and encrypted text information.

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5. The Captured Image of claim 3, captured by the Person detection process, when a person is detected in the video feed from the Video camera module;

   Wherein the captured image is fed to the Image compression process of claim 4, resulting in a compressed image.

6. The compressed image of claim 5, which is a result of the image compression process being applied on the captured image of claim 5.

7. The encoded and encrypted Text information of claim 4, formed by encrypting the encoded text information of claim 4.

8. The receiver Side Rx-SAK Board Comprising of:
   (a) Wireless Receiver Module, capable of receiving text data transmitted through wireless transmitter module of claim 2;
   (b) Text Processing Module, capable of decryption of text and decoding of text to image;
   (c) Image Enhancement Module, capable of enhancing the image quality;
   (d) Display Screen, capable of displaying images to the viewers;
   (e) Cloud Database, capable of storing all types of data and programs;

   Wherein the received text information is the text received from the transmitter, which is the same as the encoded and encrypted text information of claim 7.

9. The Text Processing Module of claim 8, comprising of:
   (a) Decryption process, capable of decrypting the text input;
   (b) Decoding process, capable of regenerating image from the text input;

   Wherein the received text information is decrypted using the decryption process to form the encoded image information;
   Wherein the encoded image information is fed to the Decoding process to regenerate an image;
   Wherein the image generated is fed to the Image enhancement process to generate an enhanced image.

10. The encoded image information formed due to decryption of the received text information through the Decryption process and the generated image formed as a result of feeding Encoded Image information through the decoding process of claim 9.

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ABSTRACT

Real-Time Person Detection and Surveillance System

India has been facing the issue of illegal trespassing from neighboring countries for a very long time. This problem poses a significant threat to our national security. In 2022, More than 2000 illegal trespassers were apprehended by the Indian Security Forces on the border of India and Bangladesh, with many remaining undetected. Despite the robust surveillance capabilities of the Indian Security Forces, certain remote and challenging terrains make human or aerial object surveillance difficult. Thus, an effective solution is required.

This invention is a novel surveillance system which addresses the shortcomings of the conventional surveillance methods, specifically in the remote or inaccessible regions. Thus we have proposed Tx-SAK and Rx-SAK boards that generate a unique system which is the combination of hardware and software to provide a comprehensive solution.

On the Transmitter side, a high quality video camera is connected to ensure clear video capturing at day as well as night. The Processing module clicks an image as soon as a person is detected in the video feed, and then image compression takes place, so as to reduce the size of data being transmitted, in order to eventually reduce any error in transmission. Then the image encoding takes place and converts the image to an ASCII text. For adding an additional security layer, the text is then encrypted to safeguard it against any threats in the transmission phase. This encrypted text is then ready for transmission wirelessly.

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Meanwhile, the receiver side receives the encrypted text. It then decrypts the text and decodes it to generate an image. This image is the same as the compressed image on the transmitter side, and is low in quality. The image is then fed to an Image enhancer, which increases the quality of the image and ensures it does not lose any important information. This enhanced image is stored in a cloud database, so as to keep record of intruder activity for future reference. Another copy of the same image is then displayed on a screen attached to the board itself, for those who wish to monitor intruder activity.

In conclusion, the proposed surveillance system effectively addresses the challenges of illegal trespassing in remote regions. Through a synergy of advanced hardware and software, the system ensures robust detection and secure data transmission. The integration of cloud storage for recording enhanced images allows for comprehensive monitoring and future analysis of intruder activity. This innovative solution provides a forward-looking approach to border surveillance, thus contributing to a safer future.

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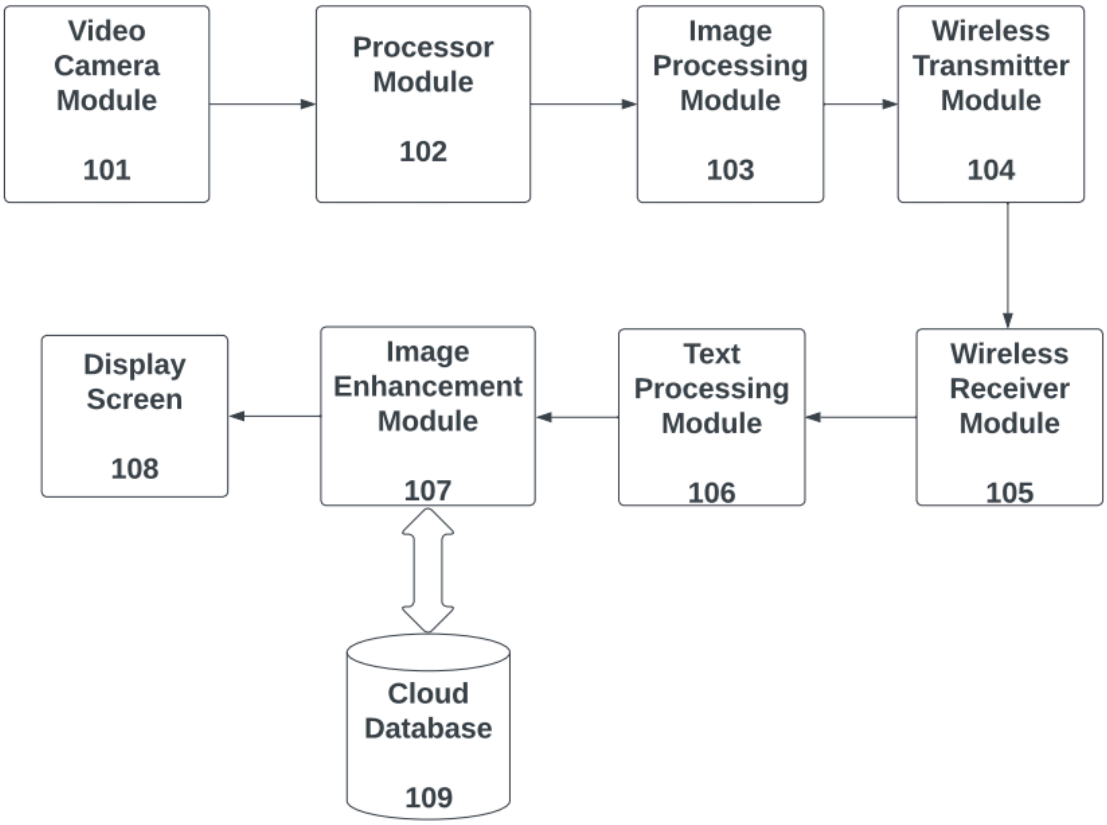

FIGURE 1 : Hardware System Diagram / Framework of System

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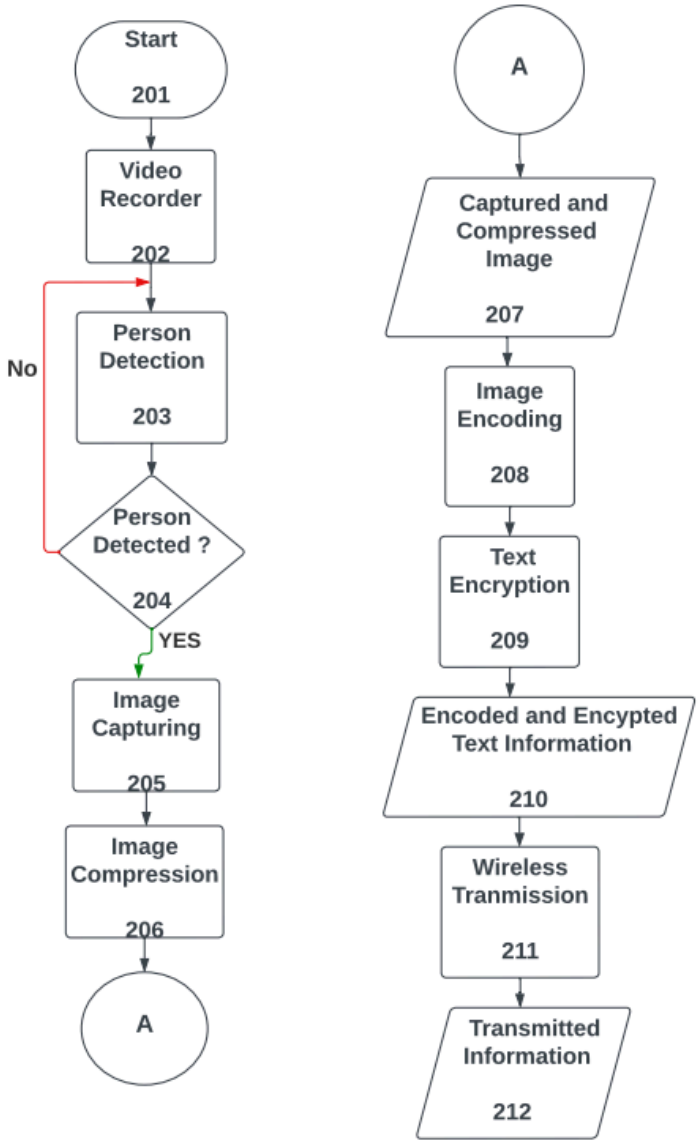

FIGURE 2 System Diagram (Software- Transmitter Side)

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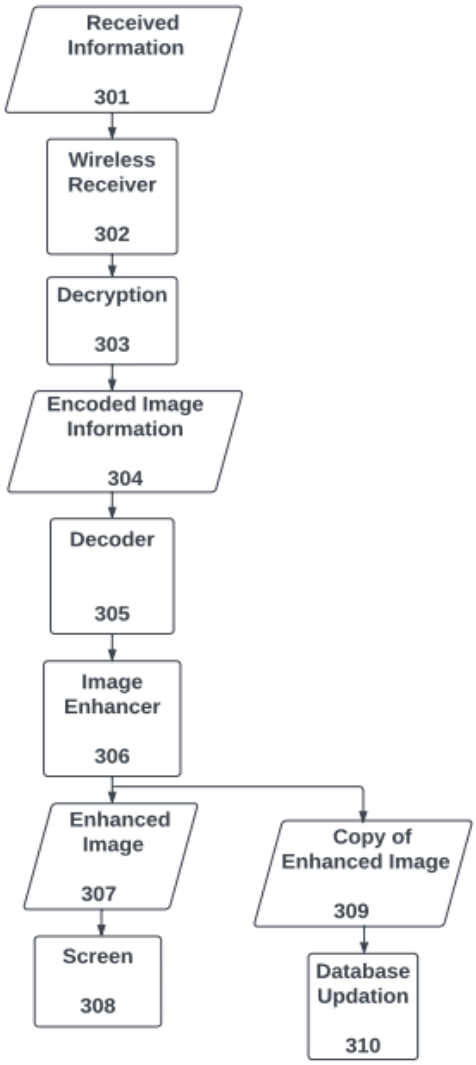

FIGURE 3 System Diagram (Software- Receiver Side)

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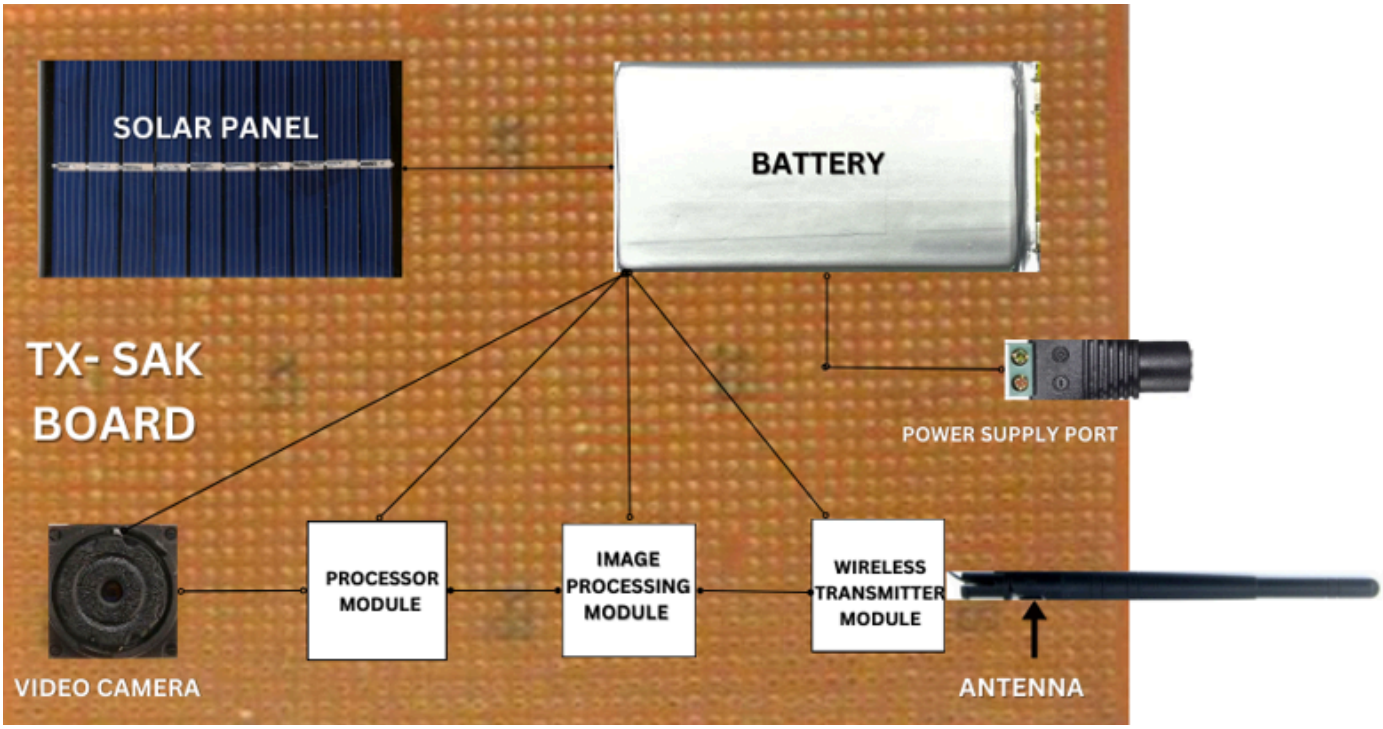

FIGURE 4 : System Infographic (Transmitter Side)

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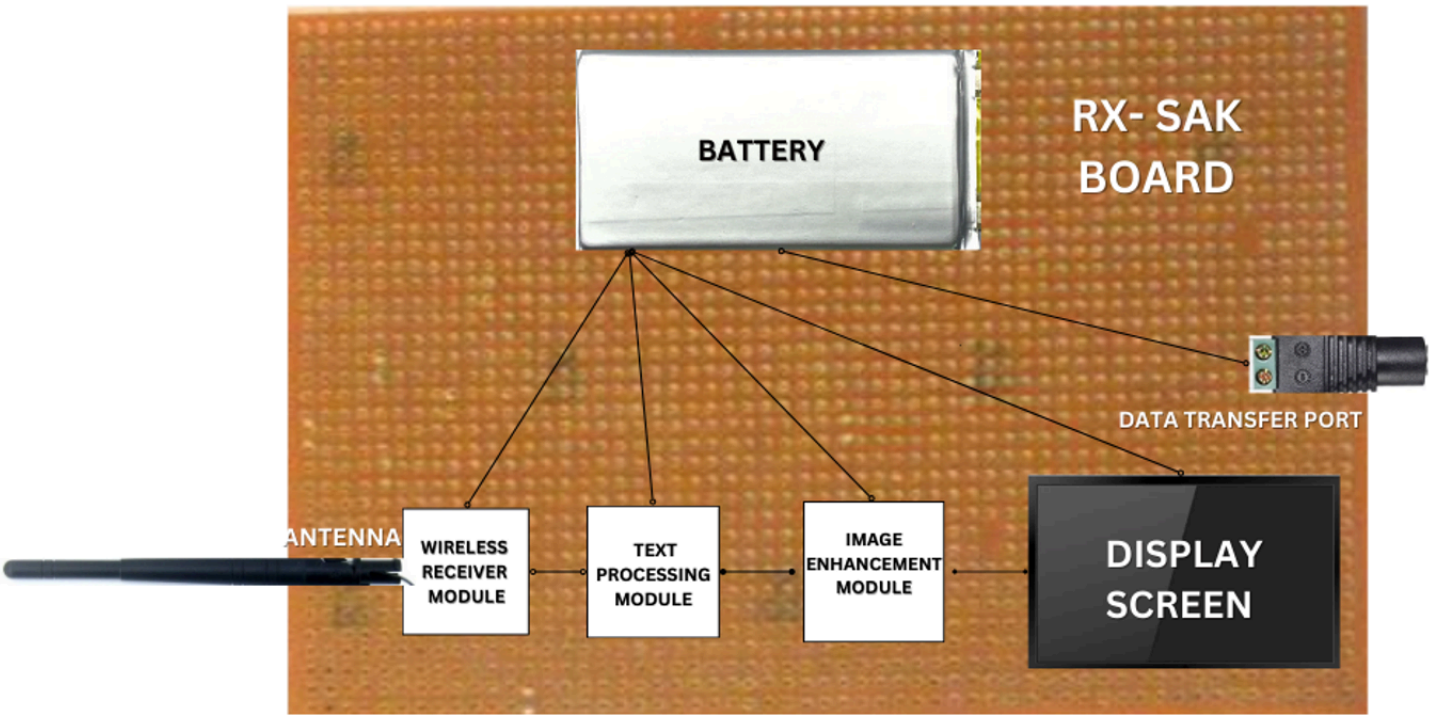

FIGURE 5 : System Infographic (Receiver Side)

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