

Encryption of Video Images Using Arduino Card

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Abstract: It is obvious that encryption field nowadays play a vital role in securing sensitive data in all means of communication or establishments including wired, wireless or the Internet. Among the three main types of communication media, Video is considered the most common and preferable type that is used in all social communication sites. However, as the rates of electronic crimes increases day after day, it is required that the process of capturing and transferring video be secured with the mostly secured and less costly method to protect the privacy and security of people. On the other hand the field of using embedded platforms using dedicated cards such as Arduino, Genuino and raspberry pi has now witnessed a new way to improve or add a new set of specialized functionalities to common devices such as wireless cameras.

In this research a new system is proposed in order to capture video images from a camera and encrypt them directly using Arduino card without the need to use a computer or dedicated server. The camera is controlled remotely in order to capture and encode video images remotely by programming the embedded Arduino card with the camera to do these functionalities. The results of this new technique implemented in this research are good and achieved the main goals of the imposed system.

Keywords: video image coding, Arduino card, cryptography.

1-Introduction:

Information data security is one of the most important considerations in any institution nowadays. Protection of the information is necessary to establish and maintain the trust and privacy among the communicating parties. In addition, timely and reliable information is necessary to process and deliver data in the right consequences. Information security is the process by which an organization protects and secures its systems, media, and facilities from unauthorized activities [1]. In addition, multimedia nowadays is one of the most popular formats in data storage and transmission areas. Due to the vital role of multimedia data in digital world, the necessity to secure it is becoming more

and more important. Every day large amount of multimedia data is transmitted through the Internet which imposes some real security issues, such as unauthorized access. The wide use of digital images and videos in various applications calls for serious attention to security and privacy of these types of data. Data encryption comes to face these issues and improve the security level of digital world [2].

On the other hand, the massive growth of technology in the field of electronics has made a great change in everyday life. The concept of using embedded platforms using specialized cards such as Arduino has now become a new way to improve or add a new set of specialized functionalities to common devices such as wireless cameras. These new platforms lead to increase in the performance of such devices. For example, instead of buying the device that is setup somewhere in the home or outside, connecting it to Wi-Fi network, and then accessing the video stream using the interface given by the manufacturer which is quite limited with camera capabilities, you can build by yourself a new application that suits your needs. This is done by using Arduino card with some other small tools [3]. In this paper, a new proposed system is built to design a new version of wireless camera capable of doing the process of encryption using Arduino card. The following sections show the details of this work.

2-Related works:

The proposed work depends on two main concepts: the first is the encryption of video images, the second is using Arduino card combining it with the

functionalities of the camera. Many researches and articles are published that deal with those two concepts. However the using of Arduino card in the process of encryption is not common. Combining these two fields with the process of encryption will provide a great advantage to the proposed system. Here are some works that are related to the proposed system:

A method was proposed in paper [4] in which the image data is encrypted and decrypted using AES algorithm .The implementation in this paper depends on 128 bit representation of AES for image encryption and decryption which is synthesized and simulated on FPGA family of Spartan-6 using Very high speed is integrated in the circuit of Hardware Description Language (VHDL). The results show that the implementation of AES algorithm is one of the best and most successful encryption and decryption standards available in market of image encryption.

Paper [5] presents an efficient and effective framework for the design and development of enhanced selective video encryption scheme based on AES to prevent unwanted interception and viewing of any video while in the process of transmission. This work depends on encrypted I-frames bitstreams instead of the whole frames to reduce the cost and maximize the speed of encryption and transmission. The results show that the proposed method provides adequate security to video streams and has no effect on compression ratio and the quality of the original video.

A design of a smart home system is described in paper [6] which is composed of a number of nodes connected wirelessly to the base station. The job of these nodes is to collect data and send it back to the base station where a microcontroller and an Arduino board interpret the information. The intent is to make a person feel safer in his home, and provide him with a way to monitor his home from a computer or smart phone while away. The results of this paper show that this work was successfully designed with the complete working prototype implementation program.

Paper [7] deals with design of a smart parking car system which consists of four main subsystems; the first is the design the power supply. The second is the sensor subsystem circuit which includes RFID and IR sensors. The third is the LED matrix to display the free parking lots, authorized, and unauthorized personnel. The last is the processing part using Arduino controller subsystem. The main goal of this system is to provide more convenience and lessen the criticism that is commonly directed to parking garages. It also can reduce the suffering of sick and disabled people looking for a parking space.

Paper [8] introduces the design and the implementation of a Smart security system for home protect using Arduino and the wireless RF to build a password based digital lock with vibration sensor for theft detection. The wireless communication system sends signals for the indication of theft. The system has an easy to use for monitoring. The results of this system show that this system is easy to install and use because the communication of the system is completely wireless. The system is also low cost, low power consumption, easily operable and has the ability to transfer other information such as voice and picture rather than just alarm signals.

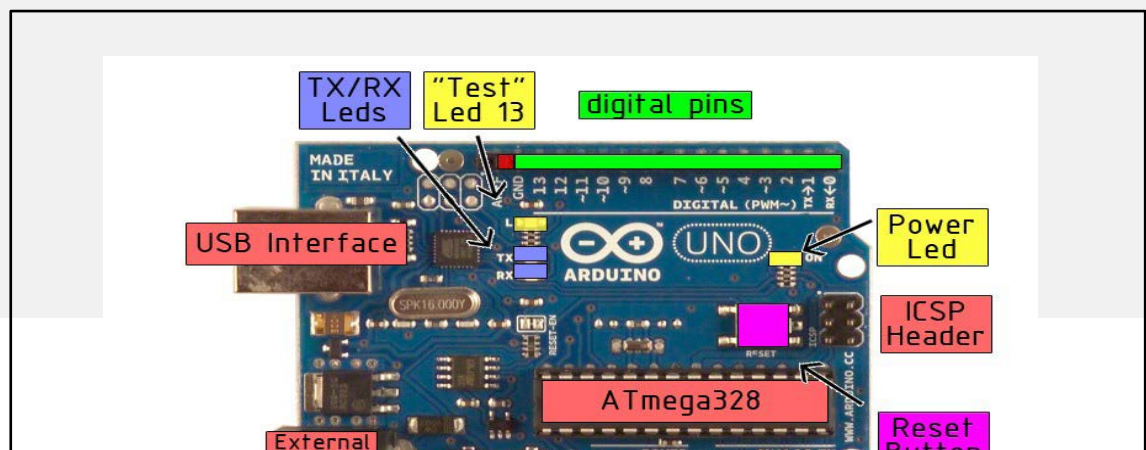
Security system is developed in paper [9] which aims to be a low-cost and intelligent security system using thermal heat, passive IR, proximity sensors and Arduino Uno board which acts as a microcontroller. This unit work is to receive continuous data from all sensors and processes it. The Arduino will trigger an alarm and alert messages will be sent to user's mobile via GSM in case of untoward situations. The results of this paper show that this work could be developed to provide a smart GUI using an Android application and an efficient algorithm to detect patterns and using the Ethernet servers using an HTTPS internet website, so as to communicate with the standalone system from anywhere in order to bring down the operation cost.

A prototype is designed in project [10] which is based on the Arduino Yun. This card is connected to a standard USB webcam and a PIR motion

detector to create two applications. The first is for a security camera that takes pictures when some motion is detected and stores them through the USB camera on an SD card inserted into the Yun. In addition, these pictures are automatically uploaded to Dropbox at the same time. The second is to stream video coming from the camera directly on YouTube so that it could be accessible from anywhere in the world so that one could check what is going on in the camera location. The results show that this project could be extended by adding more Yun and cameras modules to have a complete video monitoring system.

3- Arduino card description:

Arduino card is a tool for building small computers that can interact with the physical world objects of everyday life. It can be used to connect sensors that detect light, sound or pressure and then do some functionality such as turn on a light, change its colour, move a motor and much more [11]. This tool changes the imaginary dream of many people into reality. This is done for many reasons such as it is an easy way to use and its language can be understood without the need to dig very deep into electronics and engineering world. For this reason it has spread among ordinary people from school kids to university researchers to artists and designers. It just needs some processing to be able to develop a new project using this tiny magnificent board. Generally, Arduino card is a blue board about the size of the hand with built in chips, circuits and microcontrollers which resemble a small computer. Figure (1) shows the components of Arduino-uno card.



Arduino is an open source project such that it is easily used to develop program and share ideas with the community of tinkerers and hobbyists that are fond in these types of projects. For this reason Arduino is set apart from a lot of other platforms because anyone can write new programs to and share them online. Even more powerfully, special code collections called libraries extend the things which could be done with Arduino such as connecting cameras, motors, printers, scanners, remote controls...etc.

To begin the journey of programming with Arduino you could either use the Integrated Development Environment (IDE) or program is directly with C language. The IDE is a special program that allows the developer to write sketches for the Arduino board in a simple language modeled after the Processing. After pressing the button that uploads the sketch to the board the code that you have written is translated into the C language (which is generally quite hard for a beginner to use), and is passed to the compiler which is an important piece of open source software that makes the final translation into the language understood by the microcontroller. This step is very important because all the complexities of programming microcontrollers are hiding in this step. Figure (2) shows the programming cycle on Arduino card.

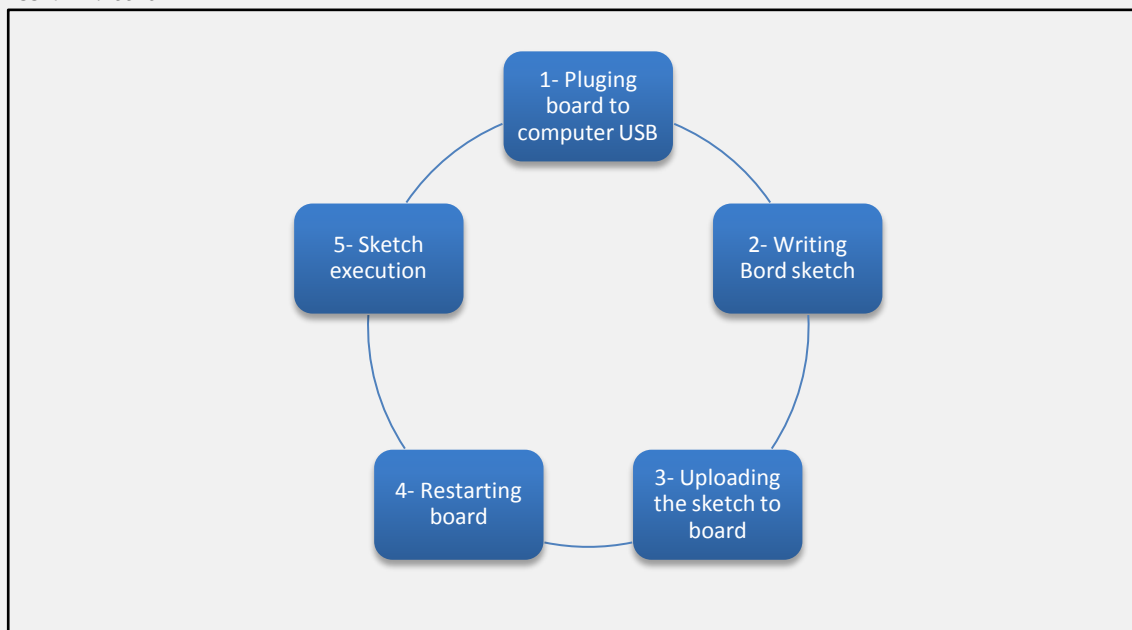


Figure (2) Arduino programming cycle

4- The proposed system:

The main goal of the proposed system is to design a secure remote video communication system using wireless camera and Arduino card. In order to understand this goal the following scenario is proposed. Suppose that a person wants to monitor a location remotely using wireless camera. In ordinary case the person should go to camera location from time to time grab the video or provide the camera with a new memory or change the options of the camera...etc. However with Arduino card new possibilities could be found. The person could control the camera remotely and reach its command remotely using Wi-Fi for example sending the video, setting timer or erase the memory without the need to go to the location and do it manually. Figure (3) shows the main architecture of the proposed system.

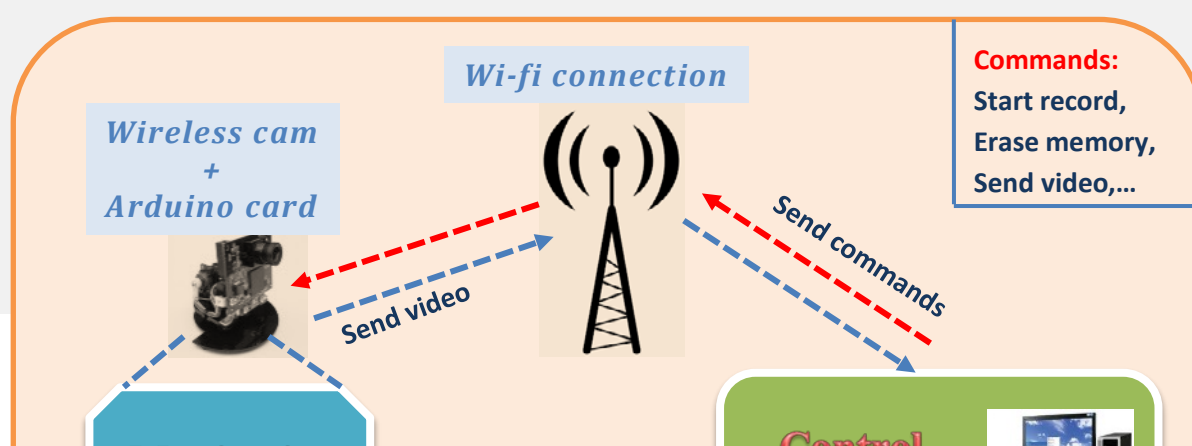


Figure (3) main architecture of the proposed system

However the main problem is that the video and information transmission are not secure through wireless communication especially if the information is sensitive. Any intruders could monitor and for this reason a secure algorithm should be applied to secure the connection between the camera and the person.

The common solution is to use the process of encryption. However the main question is how to apply the encryption process. In general case the camera should be connected to a station or server to implement the process of video encryption in order to keep the privacy until reaching the receiver. But in this case there are some limitations and difficulties and the security could not be fully ensured. The proposed solution is to change the ordinary camera to a smart camera that is able to implement the process of encryption by itself. This is done by using Arduino card in addition to memory SD card to increase the ability of the card to process the video stream. The first step of implementation is to program the encryption algorithm into Arduino card. The selected algorithm is AES because it is one of the most common symmetric encryption algorithms used for video. After implementation the card is connected with the camera and placed in the desired location. The following steps show how the system works:

- 1- The camera starts to capture the video.
- 2- The video is stored into SD card.
- 3- Arduino card reads the video as a sequence of frames.

- 4- Each frame is encrypted using AES algorithm implemented inside Arduino card.
- 5- Encrypted frames are sent to the receiver through wireless communication.
- 6- The receiver decrypts and displays the video stream. Figure (4) illustrates these steps.

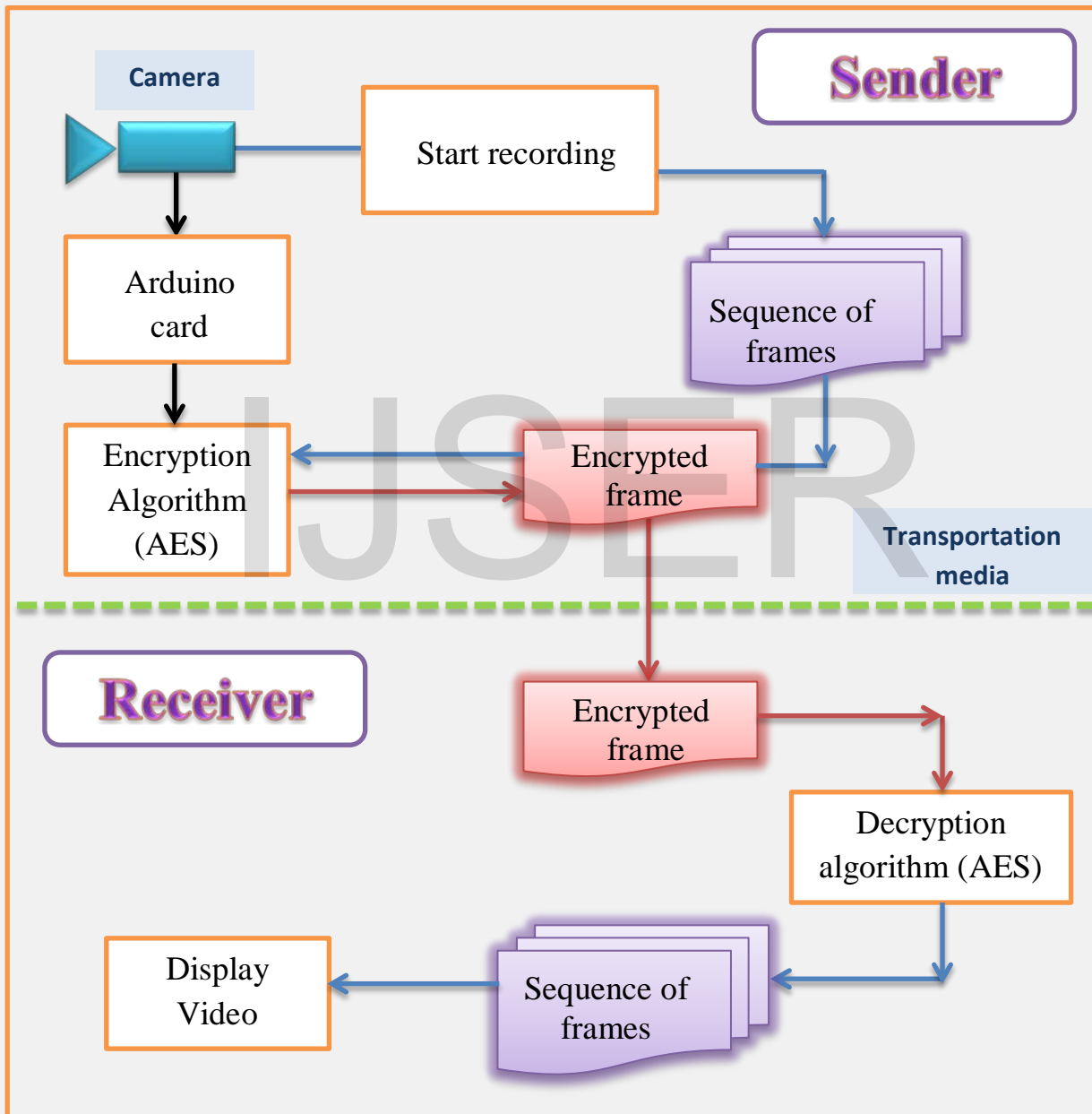


Figure (4) Implementation steps of the proposed system
The process of key exchange is ignored in the implementation steps in order to focus on the main goal of the system. In the end the results of the proposed system tend to provide lower cost, more portability and more security.

5-Conclusions:

The field of using embedded platforms could change ordinary devices into smart devices. When this work is applied the result that appears may be discussed in the following points:-

- 1- In the proposed system an encryption method is built inside Arduino card in order to make the camera act as a secure camera that sends video and images securely to the receiver.
- 2- Encryption method is AES algorithm that is used to encrypt the data that is received from camera and this data is sent by Wi-Fi to computer as a receiver.
- 3- Also when the computer sends any message to camera this message is encrypted.
- 4- Arduino card has proved the speed when the data is sent and the images that come from camera are saved.
- 5- In the future, several improvements can be added to the proposed system to allow for more protection and more functionality.
- 6- These include building a full monitoring system that could track and recognize specific patterns in the area. It also could use multiple cameras that have communication abilities among them.
- 7- In addition other security algorithms could be applied such as integrity and digital signature to provide more protection to the system.

6- References:

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