The Performance Of Electronic Article Surveillance System (EAS) With UC-15 For Laboratory Security

Surasee Prahmkaew

Abstract: This research aims to develop the higher security system at university's computer laboratory room. The system integrated of EAS, Arduino and 3G module (UC15-T) in box which is created to notify for better security system. Arduino microcontroller that are using as preliminary stand-alone box, then we program to control this device to send the notification to laboratory administrator via short message service. The EAS used RFID tag as trigger to detect person to bring the RFID which attached to the valuable things across the EAS pole. Then the Arduino detect the signal from the EAS system if one of any RFID tags across the pole mean stealing occurs, then the Arduino will order the 3G module (UC15-T) to send the short message to notify laboratory administrator. The system is well performed, reliable, and give us with impressive results

Index Terms: EAS, better security, 3G module, Clock, Synchronous, Delay.

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1 INTRODUCTION

THIS This system aims to prevent valuable devices get loss from the University's laboratory. The system has integrated EAS technology [2], 3G module (UC15-T) [5], and microcontroller [1] together. This system can help to decrease the burden lecturer works and staff beside sitting inside the room to watch over students. The researchers found that the previous usage of the laboratory room is required a lecturer or staff to regularly monitor student using the devices, sometimes lecture or staff has other task to operate and needed to go out the laboratory and left students to stay and perform experiment alone without staff or lecturer to monitor, some small valuable equipment can be lost. By this circumstance, staff or lecturer will be responsible for devices lost or equipment in the laboratory, most the devices which are stolen quite small and expensive, such as WiFi antennas, mouse, cables. In addition, lecturer or staff feel unhappy for this circumstance. With this propose system, it can help lecturer and staff to work with more efficient due to not to watch over the laboratory room. The propose system will notify and monitor the thief via SMS application, by sending the SMS to the laboratory room administrator or lecturer

2 TECHNOLOGY REVIEWS

2.1 Electronic Article Surveillance System

EAS (Electronic article surveillance) is a technology applied devices to prevent theft or reduce cases of stealing from retail stores. It applied to another popular place by install the anti-theft pole such as the library to prevent the smuggling of books, publications, to be out of the library. In such a case of

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library to be used a pole anti-theft system together with the loan-return system as joint inspection. As this application are equipped with a special tag to be used as a detector paired with a pole, it is yarded or removed if the product is properly removed. If not correct, the alarm will be alert. Anti-theft antenna system or radio anti-theft system consists of the following devices.

• Antenna is installed at the exits way out, it can be installed more if there are many exits way out. The antenna will detect the radio signal from the tag where the shop attached the tag on the product, when the antenna work by emitting the radio waves in detecting the signal precisely Metal objects, keys or cards will not affect the signal tower but tag only.

• Tag [9], there are 2 types: HARD TAG and SOFT TAG. HARD TAG is a tag that is widely used in clothing stores, bags, shoes, wines, etc. by using it in conjunction with a strap. Which has many forms Both large round pieces Pin type a little small. Prices will vary. Each format is suitable to support different devices.

SOFT TAG or LABEL TAG is made of paper by attaching it to the product itself, such as a package of cosmetics, perfume, food. Extra and special LABEL TAG is used in conjunction with a special box. Which is often used with CD, DVD as well

• **HARD TAG DETACHER (DETACHER) / DETACHER (DEACTIVATOR)**

The machine to remove HARD TAG for pulling the strap, where HARD TAG attached to the product. The radio wave breakers will break the radio wave signal on LABEL TAG in an easy way by bringing the LABEL TAG through on the signal shredder only. The radio wave signal will disappear, the process is easy and fast, convenient for the user. About the types of or radio anti-theft system can be classified by the radio frequency as follow

• **Electro-magnetic systems or EM towers**
This type of anti-theft pole (EM) is a pole used with an electromagnetic tag. With low frequency Using magnetic

induction to detect with a device and it is difficult to use. This is because electromagnetism has to be added and removed electromagnetic. This application is more popular to use in the library system, general retail stores. It is durable equipment but has a very expensive when compared to other systems. However, it provides more security and accuracy for both Hard Tag and Soft Tag, they have a durability rating of more than 3 years, making them a worthwhile investment in the long term.

- **Acousto-magnetic systems or AM poles**

It uses the same electromagnetic principle as EM, but with reduced capability. It changes the material of equipment to be used (quality of the metal used to make) to reduce the price of the pole. It joints equipment. It is commonly used on frequency 50+ kHz for stability. The distance obtained is greater than the RF model, the price is in the middle range. It is not as expensive as EM and not as cheap as RF, with greater range and higher price. More resistant to metal. Main advantages are it can be used with RF Soft Label, it can reduce the cost of tag but will not get the maximum capability of anti-theft system. Because the signal received is not suitable for the anti-theft antenna in AM format

Fig. 1. EAS system

- **Radio frequency systems or RF towers**

Antenna uses a wave from 1.75 - 9.5 MHz as same as RFID system used. It applied in the era of the subject of RFID with a cheap price. It is popular among stores everywhere but major problem will arise with the Soft tag, that is, it cannot be used with many types of products that contain metalize, including coffee sachets, freuds, boxes with some type of reflective coating. But it is capable with most products Therefore, when choosing a product, it is necessary to separate the product so that it can choose the best anti-theft pole type that supports the function. For the needs of used.

2.2 3G module (UC15-T)

3G Module Board is a 3G mobile phone network communication board using Quectel brand communication module. Model UC15-T supports frequency at 850/2100 MHz in UMTS (3G) system and supports frequency at 850/900/1800/1900 MHz in GSM (2G). It has the data communication speed between the module and the network at 3.6 Mbps for Downlink and 384 Kbps for Uplink, when it connected to a 3G network. The purpose of using this device

is ideal for those who want to allowing the system to connect to the network 3G or those who want to upgrade their system from 2G to 3G with comprehensive functionality for both communication and geotagging. It can be applied in various applications such as transportation and monitoring systems for example Location of cargo trucks, smart meter, point of wireless selling products, Security, Public health work Monitoring of people, control and Long-distance maintenance etc.

Fig. 2. 3G Module (UC15-T)

2.3 Microcontroller Arduino

Arduino is the open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. The history of Arduino is an Italian initiative project. The story started in 2005, Arduino pioneers "Massimo Banzi" and "David Cuartielles", who lived in Ivrea in northwest of Italy. These two guys intend to make an inexpensive microcontroller that students can access. The small factory in the city was used to produce the first Arduino board under the name of their project Arduin of Ivrea. In addition of intention to make the price of the device to be cheap when it compared to other microcontroller families in the market, they also set up the Arduino to be developed by a "free" program under the terms of the open-souce environment, so they chose to use the development based on the wiring and connecting system. The microcontrollers, in any case, are like the human brain. It is responsible for thinking perform mathematical calculation, interpret the logic command, using memory to contain data as sources in calculations or processing. But it will not be able to work without hands, feet, arms, legs or eyes, ears, nose, which is comparable to accessories to be used as sensors, motors, communication systems via the Internet, the monitor, etc. In summary, the microcontroller will do the calculation. gets the value from the external measurement system and brought into processing and direct the response to other connected devices. As itself alone, it can't do more than thinking.
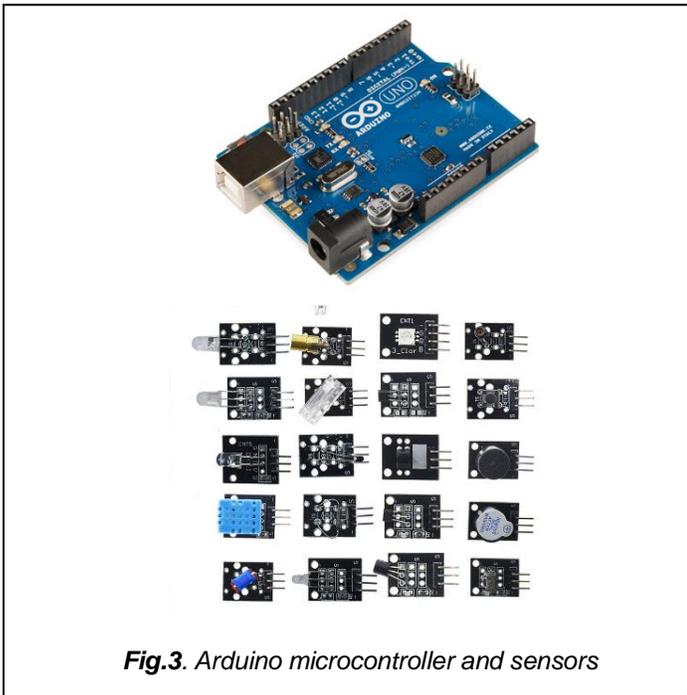
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Fig.3. Arduino microcontroller and sensors

3 SYSTEM AND MODEL DESIGN

The proposed system composed of the EAS system which is setup at the entrance of the laboratory room as show on Fig. 6., EAS is always detect the RFID tags radio wave. If RFID tag which attached to the valuable things has pass through the EAS pole, this means that someone perform stealing or bringing out valuable things from laboratory room. Such this event is happening, the buzzer of the EAS system will alarm. Arduino microcontroller which is used to keep track of the voltage signal from the EAS's buzzer will command the UC-15 to send alert SMS to laboratory administrator. After sending alert SMS message, Arduino microcontroller will be back to keep track the EAS's buzzer voltage again and waiting for that voltage until this circumstance will be occur again (stealing). The Arduino microcontroller and UC-15 had programed in C code to perform those functions as the system needed. The propose system connection diagram shown in Fig.6. The voltage sensor will tap the EAS buzzer voltage where its generated 24 Vdc and 0 Vdc, Voltage sensor itself had supply with 5 Vdc from the Arduino microcontroller and Voltage sensor signal connects to the pin Ao at Arduino microcontroller. The UC-15 had supply by the AC-DC power adapter at pin VIN and GND, UC-15 will connect VREF to Arduino pin RST, PowerKey to Arduino pin D3, TX to Arduino pin D1, RX to Arduino pin D0 and GND to Arduino pin GND show on Fig.6. The program flow chart of the proposed system is illustrated in Fig.5 also the hardware composed into the box as illustrated in Fig.7.
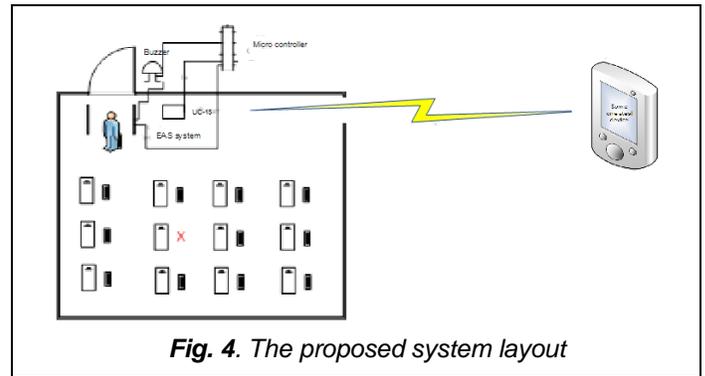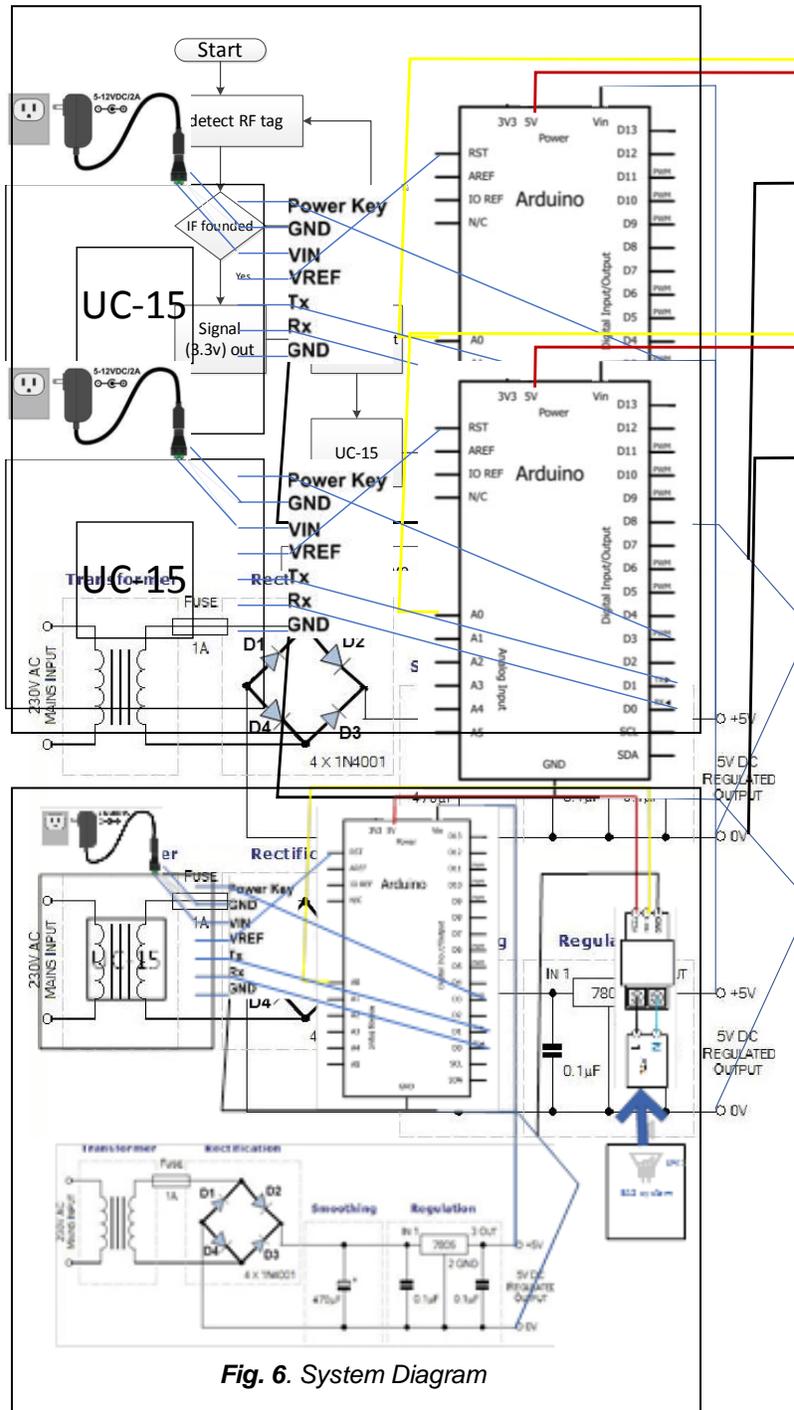

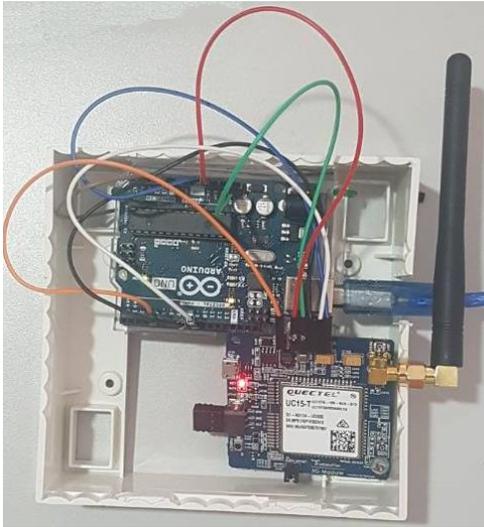*Fig. 4. The proposed system layout*

Fig. 6. System Diagram

Fig. 7. *Proposed system box*

4   SYSTEM PERFORMANCE EVALUATION FACTORS

The system performance evaluation has performed base on system reliability [12],[13], availability [14] and accessibility. Reliability is calculated as an exponentially decaying probability function which depends on the failure rate. Since failure rate may not remain constant over the operational lifecycle of a component, the average time-based quantities component, the average time-based quantities such as Mean time to failure (MTTF) or Mean time between failure (MTBF) which can be used to calculate reliability.

4.1 Reliability

The reliability mathematical function is specified as

$$R(t) = e^{-\lambda t} \tag{1}$$

Failure rate is specified as:

$$Failure\ rate(\lambda) = \frac{1}{MTBF} = \frac{1}{MTTF} \tag{2}$$

Where MTBF is specified as:

$$MTBF = \frac{total\ Hours\ of operation}{Total\ number\ of\ Units} \tag{3}$$

MTBF= (total Hours of operation)/(Total number of Units)

$$MTBF =\ 1/\lambda \tag{4}$$

Where MTTF is specified as:

$$MTTF = \frac{total\ hours\ of operation}{Total\ number\ of\ failures} \tag{5}$$

$$MTTF = \frac{1}{\lambda} \tag{6}$$

4.2 Availability

Availability determines the instantaneous performance of a component at any given time based on time duration between its failure and recovery. Availability is calculated using the following formula:

$$Availability\ A(t) = \frac{MTBF}{MTTF+MTTR} \tag{7}$$

Where Mean time to recovery (MTTR) is specified as:

$$MTTR = \frac{total\ hours\ of Maintenance}{Total\ number\ of\ Repairs} \tag{8}$$

$$MTTR = \frac{1}{\mu} \tag{9}$$

4.3 Accessibility

Accessibility[11] means providing flexibility to accommodate each user's needs and preferences on this system.

5   RESULT AND DISCUSSIONN

The proposed system has installed at computer laboratory room 2743, Faculty of Industrial Technology, Phanakhon Rajabhat University since August 1st ,2020. 3 months period is measurement time to collect the system efficiency results. The measurement parameters for the system efficiency will evaluated as Reliability, Availability and Accessibility. The results founded as illustrated on Table 1. and results of Short message notification alert as shown in Fig 10.

Table 1. *The results of the proposed system*

Time	Parameter name		
	Reliability	Availability	Accessibility
Aug	100%	100%	100%
Sep	97%	94%	100%
Oct	97%	94%	100%
Average	98%	96%	100%

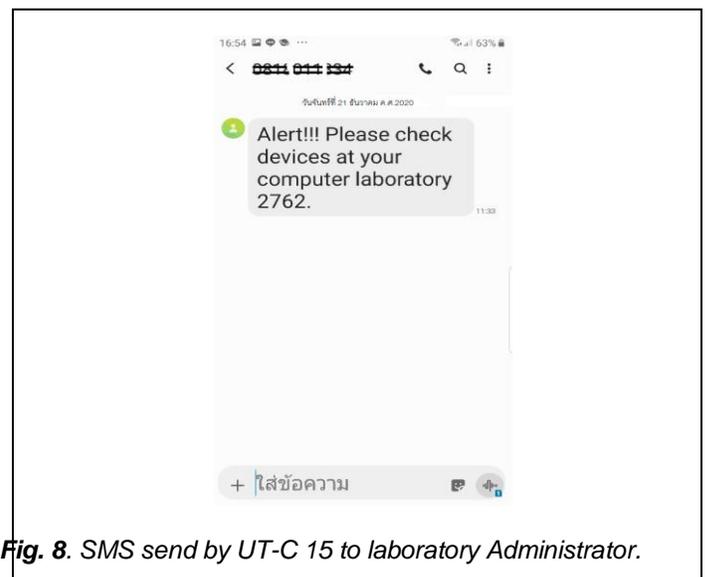***Fig. 8***. *SMS send by UT-C 15 to laboratory Administrator.*

The results are impressive, 98% reliability, 96% Availability and 100% Accessibility. The problem of incomplete availability and reliability of 100% due to the power outages for long time even through the power supply is deploy to the system.

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