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Multi-response simulation optimization approach for the performance optimization of an Alarm Monitoring Center

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ABSTRACT

This study offers a multi-response simulation–optimization approach to optimize an Alarm Monitoring Center's performance. In this paper, the multi-response simulation–optimization application is firstly addressed in the Alarm Monitoring Center. Five performance criteria affect the performance of Alarm Monitoring Center and five factors, each of which has three control levels, are identified. The data belonging to the performance criteria, which are determined, are obtained with the help of the running scenarios combining with the factor levels using Taguchi design. Then, signals to the noise (*S*/*N*) ratios are calculated for these which are obtained from the performance data. A decision matrix is generated with *S*/*N* ratios; the TOPSIS method is used to transfer the multi-response problems into the single-response problems. The system improvement rate is also determined by finding the levels of factors to optimize the system using Taguchi's single response optimization methodology.

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1. Introduction

The need for reaching relevant authorities, especially in the security problems, has recently increased in parallel with the developments in the information and computer technologies. Since 2001, the safety and security issues have gained major importance all around the world, creating one of the fastest growing industry sectors. The state in Turkey is not different (Ilgaz, 2007). Among the European countries, Turkey ranks second after Poland in the size of its private security guards. Although Turkey has been dealing with socio-economic issues for last decades, the increases in safety threats have made the security a prime concern for citizens. The security sector in Turkey especially consists of physical security services whereas in economically developed countries, the security sector is more weighted toward the methods of electronic security. Therefore, it can be expected that as the Turkish economy develops, a change toward the methods of electronic security will occur (Ilgaz, 2007).

"Alarm Monitoring Center" (AMC) is a newly developing concept in Turkey. The alert systems, which are established in houses and workplaces, send information to related alert monitoring center nearby any alert situations, and provide the intervention of police or fire department or health care departments for various alert types (robbery, fire, etc.). Alert monitoring centers provide service for 7 days 24 h. The receptors of these systems transfer incoming alerts to computer screens which sort by importance of alert. Every communication detail of the alert place is automatically provided to operator. The alert monitoring center performs certain procedures and processes, which was determined before.

House and workplace alert systems are typically composed of fire and robbery alert systems. The main purpose of robbery alert systems is to sense the passage of any persons in the time intervals which are determined. In practice, these systems accept every entry in the time intervals, which are determined, as robbery and send information to the alert monitoring center. Many different sensors are being used in buildings in order to sense unwanted entries and to send these senses to the desired centers as electrical signals. Robbery sense sensors or perimeter and interior detector devices can generally be classified; ultrasonic movement detectors, passive infrared detectors (PIR), sound detectors, light sensors, capacitance sense detectors and acoustic glass break detectors (Eren, 2006).

The fire monitoring systems are the electronic notification alert systems, which sense the fire incidences in the region by sensors. These are generally used as building fire systems: ionization, optical smoke type of fire detectors, fixed temperature, temperature rising speed detectors, linear temperature rising detectors, heat type detectors, flame detectors, sound alert/horns, sound – flash alert horns, analog addresses, and conventional fire notification alert panels (Eren, 2006). Heat and smoke detectors are the most widely used fire detection devices. Heat detectors are designed to

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detect a rapid increment of heat in the area of the detector (CSAA, 2011). Smoke detectors could detect the presence of smoke in an area (CSAA, 2011). There are two well-known types of smoke detectors, ionization and photoelectric. Ion detectors detect a flaming fire faster; however a photo electric detector detects a smoldering fire quicker in most situations (CSAA, 2011). Carbon Monoxide (CO) or gas detection equipments are used for detection of the specific gas or vapor to be encountered (CSAA, 2011). Sensors are linked to a control unit via low-voltage wiring or a narrowband radio frequency signal which is used to interact with a response device (Elfahaksany et al., 2011).

The procedure of data collection in an AMC is illustrated in Fig. 1. The robbery alert system senses the unwanted entries to the building and, as desired, notifies the alert monitoring center about the situation. Detectors are connected to system panels, and sirens and flashers are connected to the alarms.

In any alert situations, the control panel makes the alarm equipments active due to the coming signals. Then, if the system is connected to any alert monitoring centers, the control panel notifies the central security station about the alert/failure state of system. The detectors, which provide this information, are movement detectors, glass break detectors to sense the glass breaks in first floor, seismic detectors and magnetic contacts in windows/doors. The fire alert system is sensitive to any smoke, any chemical gas, nonlinear rising of area temperature and light radiation. If the data of detectors, which are used, exceeds the certain level in security zones, these data are sent to the central control unit through the control panel by different communication methods. Then, the fire cooling systems are being activated. The computer–phone integration system is a system which forwards the coming call to operator and at the same time, provides the clients information to the operator screen. Alert zone and alert type are transferred to the alert monitoring center telephone central. At the same time, the information of conference between client and operator is reflected to the screen. So, the client conference times and alerts types are recorded to the database.

In previous researches, the performance analysis of Alarm Monitoring Centers (AMC) has not been studied. An AMC system can provide a variety of functions such as customer service, contact centers service, and technical support (Rothrock, 2011; Ma et al., 2011). AMC is similarly considered as "Call Centers" for queuing system which consists of customers (callers), servers (telephone agents), and queues. The incoming calls are classified as true or false. This is a former process of filtering without noticing to the relevant departments. True ones are forwarded to related institutions.

In this study, an AMC performance is improved. This study is the first in the literature to carry out the performance improvement of AMC with the simulation–optimization. First of all, the performance criteria of system as well as factors and their levels that affect these performance criteria are identified for performance optimization of AMC. The data belonging to performance criteria, which are determined, are obtained with the help of running scenarios combining with the factor levels using Taguchi design. Then, signal to noise (*S*/*N*) ratios are calculated for these obtained performance data. After a decision matrix is generated with *S*/*N* ratio, TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) is used to transfer the multi-response problems

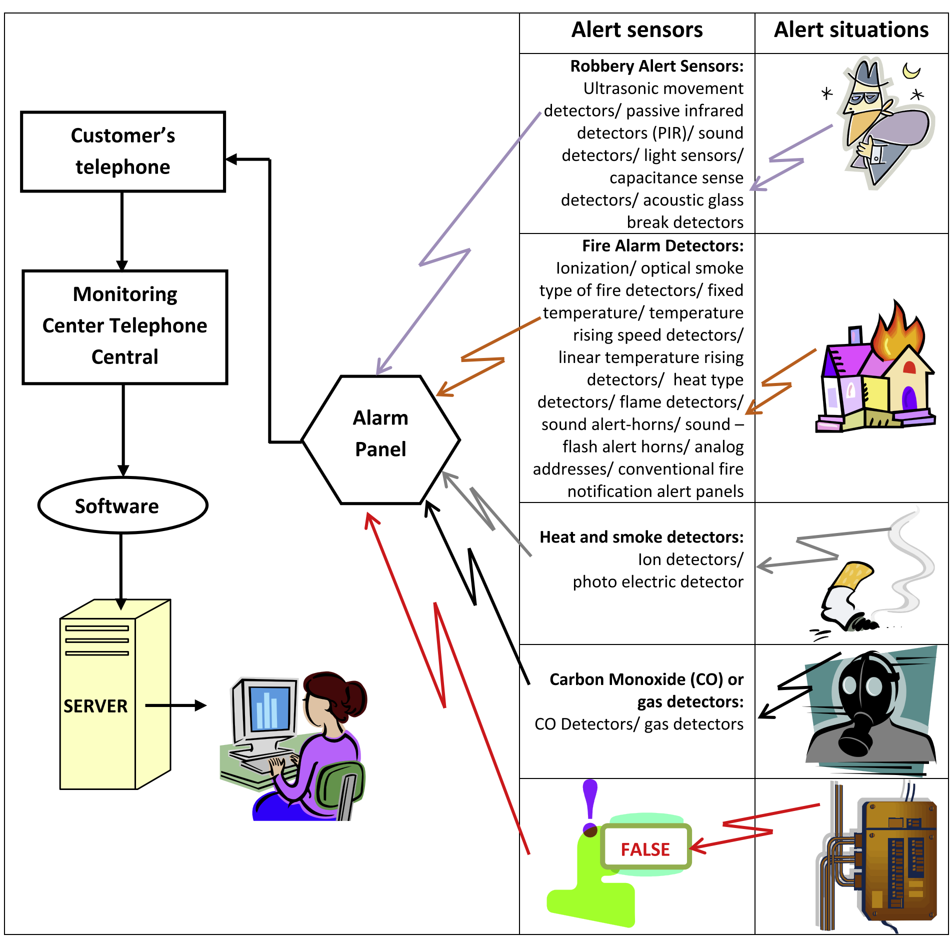

Fig. 1. Data collection procedure.

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