Wireless Sensor Network (WSN) Based Real Time Border Monitoring System

Fahad Farooq, Ali Akbar Siddique, Noman Ahmed Siddiqui, M. Tahir Qadri

***Abstract*— In recent times, the usage of technology is on the rise in every field and it's improving at an accelerated rate. As it improve it become even faster, robust and compact, so it can be used in remote locations. For any country, security is the most important aspect for their survival and because of that they closely monitor their borders by utilizing a lot of man power. It is the task of military organization for that country to safeguard their borders and they require assistance from latest technology to do so. In this regard we have proposed a system using a network of sensors implemented in such a way that they create an array to gather information from the remote location or the physical world. All the sensors are interconnected via wireless sensor network and continuously transmitting their information to the base station to process their data and take precautionary measures if any intrusion is detected. Two distinct sensors are used to identify the intrusion; they are motion and proximity sensors. Each node consists of an Arduino to acquire data continuously and transmit to base station for further processing.**

Keywords: Wireless Sensor Network (WSN), Arduino, Real Time Monitoring System.

I. INTRODUCTION

Today the growth of wireless technology and recent developments in IT sector became very popular amount the masses. Require huge amount of manpower to secure their borders.

Technology can play a vital role in this regard to reduce manpower at their border in turn lowering the cost required for border patrolling. Main purpose of the government is to provide faster, easier, intelligent and more flexible means of monitoring the borders to the armed forces rather than using manpower for the same purpose. It is quite obvious that borders are indeed long and may not be possible to cover an entire border with such technology, but we can implement it to the key locations were we know that human presence or patrol may not be a viable choice due to harsh environment. These locations are susceptible to an external intrusion.

WSN has been used for routing information from remote locations to designated base station to process and take necessary steps [1]-[4]. Fuzzy algorithms are also introduced in the past for border monitoring [5].Unmanned technology has also been utilized for border monitoring appliscations [6], [7]. For enhancement of WSN network an impact of dense cluster was also discussed by Kumar, Senthil T., Boselin SR Prabhu, and S. Sophia [8]. Majority of healthcare application are based on WSN technology [9]. Software like OPNET was also utilized for border monitoring by Alkhathami, Mosad, LubnaAlazzawi, and Ali Elkateeb [10]. Irrigation and environmental monitoring application were proposed by researchers [11], [12].

In our proposed model we set up a network of sensors implemented in such a way that they create a network to deliver information and communicate with the base station. They process the information that they acquired and deliver them to the concerned authority as soon as possible to take necessary precautionary measures if needed. WSN is an emerging domain which can be used with deeply rooted network systems operated on low power wireless modes having small processors to process information and communicate with required stations. Base station set up for these nodes will acquire data via XBee module.

II. HARDWARE IMPLEMENTATION METHODOLOGY

Figure-1 represents a block diagram of our proposed model. Proximity sensor interfaced with an ARDUINO board is used to identify a metallic object in its close proximity. Motion and PIR Sensor detects the actual movement of any object within its set limit. As soon as any object is detected by motion or PIR or even from a proximity sensor, a camera's trigger is also interfaced with our ARDUINO board to capture an image and sends it to the concerned authorities. With XBee module each node can communicate with the base station and receive further data to operate accordingly. Base station receives the information about the intrusion if it occurs and act accordingly.

The reason to use multiple sensors is to be sure that the intrusion is caused by enemy soldiers, cars or even tanks, proximity sensor will detect the metallic objects which may include infantry weapons and vehicles. PIR sensor is used as a motion sensor; it detects the movements by quantifying

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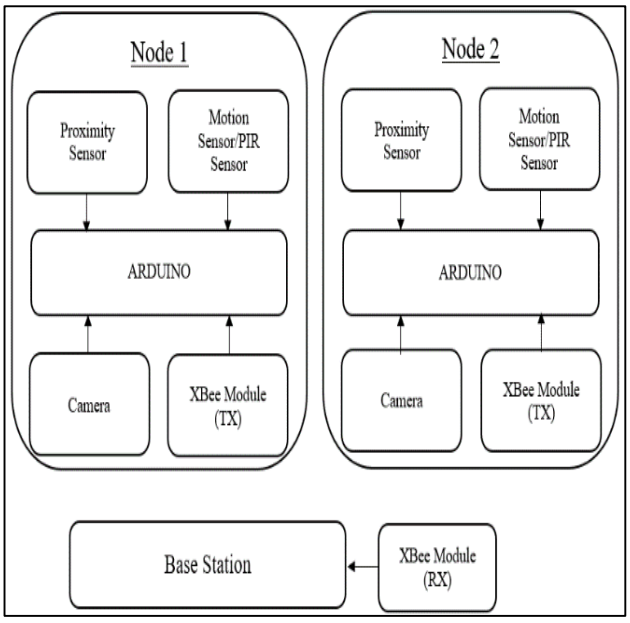

Figure.1: System Block Model

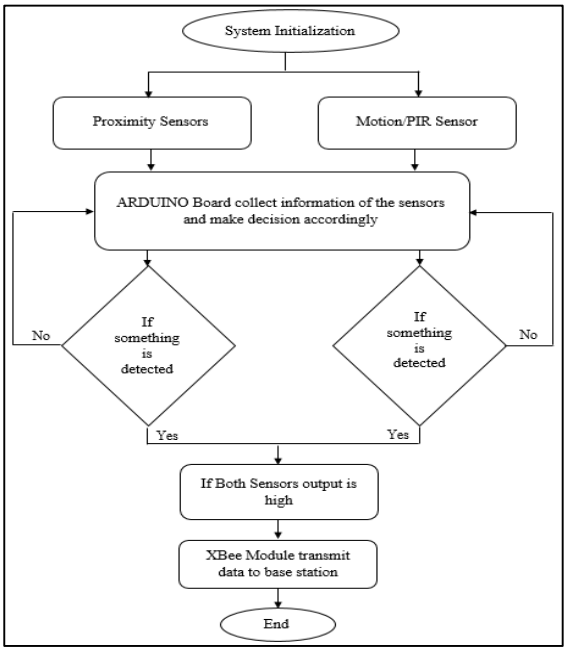

Figure.2: System Flow Control of a single Node

transmissions in infra-red levels emitted by surrounding objects.

III. SYSTEM FLOW CONTROL

A system flow control of an individual node is given in Figure.2. After system initialization sensor attached with ARDUINO will began to acquire information of remote location where the node is placed from Proximity and PIR sensors interfaced. At this stage, ARDUINO identifies if both the sensors are high and if they are, it will send a signal and alert the authorities about the intrusion, also captures an image for the accessing threat level and prepare for counter

Table.1: Threat Level Identification

Time (min) of the day	Motion Sensor Output in Velocity (m/s)	Proximity Sensor Output in (mV)	Threat level
212	2.13	12.22	No threat
551	6.06	0.259	No threat
980	3.77	0.337	No threat
1330	5.87	21.122	Possible threat
1400	12.55	39.64	Possible threat

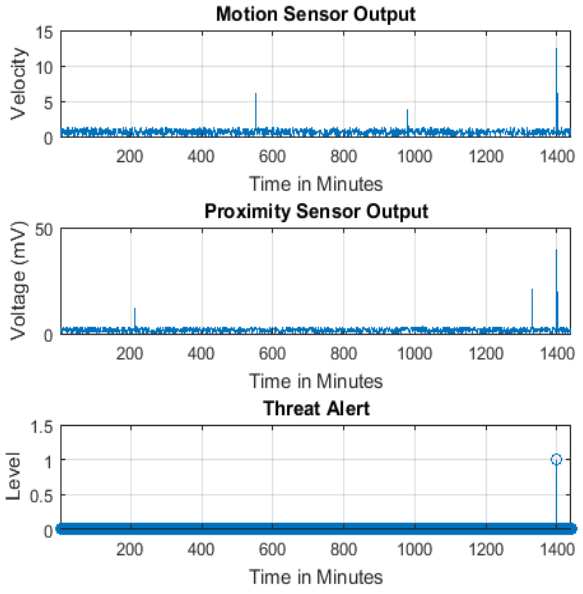

Figure.3: Node 1 parameter output.

measures. Both proximity and motion/PIR sensor must be high in order to properly access the threat level. As motion sensor will detect any kind of motion activity around it, but on the other hand Proximity sensor will only detect a metallic object within its range.

IV. RESULTS

For possible threat detection, it is necessary for both Proximity and motion sensor of a single node placed on the border. Table.1 display the threat level identification, motion sensor can sense everything that moves in its surrounding whether it is a living thing or not. For this vary reason, it became necessary to implement proximity sensor along with the motion sensor.

Table.1 shows the time at which ARDUINO sends the signal to base station at the time when both the sensors detect any presence. Base station will identify the threat and take the necessary measures to neutralize it. It is possible that if both

sensors detect any presence, there might be an enemy intrusion or it might be something else. To properly access the threat, a camera is also implemented through which we can monitor the activity. Camera will further identify an object or a person who trigger the sensors.

Fig-3 represents the threat level with respect to the input acquired from the sensors integrated with Node 1. Threshold values are selected for both motion and proximity sensors which is 5.5 m/s and 20mV (mili Volt) respectively. From table-1 at 212th minute velocity of an object was detected moving at the speed of 2.13 m/s, which is below the threshold level so there will be no threat level. Same scenario is implemented for the proximity sensor. If both outputs of the sensors exceed threshold level then an alarm signal will be send to the base station from the designated node to tackle any possible threat.

As soon as any detection occurs ARDUINO will transmit the signal to the base station accordingly. Then a person present at the base station monitoring will pan the camera to visualize the cause of trigger. Sensors plays a vital role for accessing the threat level and provide information to the concerned authorities via XBee module interfaced with each node implemented in the field. Proximity sensor will identify anything metallic but if anything is non-metallic in nature will not be detected and only motion sensor will respond. If any intrusion is supposed to happen, it will be a land based rover or any human carrying some weapon, both of these conditions are possible threats and it is necessary to take precautionary measures to tackle suck threat.

V. CONCLUSION

In this proposed model, a system is proposed which is an easy, cheap and effective way to safeguard borders as well as secured location where it may not be possible for soldiers to stay for long durations due to weather or a rugged terrain. Proposed system is based on multiple nodes integrated at the key locations that are more susceptible for an enemy intrusion, if there are no soldiers patrolling the specific area. Two nodes that we implemented were kept at a distance to 1.5 km based on the distance covered by XBee module we implemented. System performed within its designed parameters and it’s a best way of surveying. By collecting information from the border accurately and send it to the authorities to take necessary measures.

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