Mobile based Application Design of Wireless Motion Detection for Home Security

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Abstract— **Smart home security becomes necessary given an increasing level of criminality. Home security needs certain innovation that utilize the advancement of computer technology. Current security system only focuses on giving a warning when and where incident occurs. This paper proposed an Internet of Thing (IoT) system to monitor a house remotely and timely manner using smartphone application. A mobile-based application of Wireless Motion Detection is designed to support home security. It uses a wireless point to multipoint technique for each accelerometer and node sensor that connect to a microcontroller. The reason of using a wireless network on this system is because it is real-time, simple on implementation, and flexible on installation. This system will be one of the practical home security solutions that efficient and effective because of the Android applications for monitoring motion detection conditions at home in real-time.**

Keywords— Internet of Things, PIR sensor, Motion detection, Android, Home Security

I. INTRODUCTION

The need of home security system is now paramount. Houses and its surroundings need to be fully protected from malicious disturbances that come from outside or inside [1]. Criminal rates (theft and robbery) on household from 2013 to 2015 is extremely high despite fluctuations. In 2015 the number of thefts with violence in households was at 1,628,634 and 140 out of 100,000 people are at risk of getting a crime [2].

Internet of Things (IoT) is one of the solutions to this problem. IoT is a concept that aims to expand the benefits of continuously connected internet connectivity, along with remote control capabilities, data sharing, etc., including objects in the physical world, foodstuffs, electronics, any equipment, collections, including living things which are all connected to local and global networks through embedded sensors and always on [3].

At this time, there are five out of ten home security devices on the market that need expensive cost on the installation, not very practical and consuming space. Furthermore, the device cannot be connected to the internet for remote monitoring and emergency notification requires a monthly subscription fee that is quite expensive [4].

Lately, the development of the IoT has good potential for the future, where IoT devices themselves aim to make humans easy to carry out various activities every day with secured home. According to the results of the Juniper Research study, there has been a threefold growth of the IoT devices between 2016 and 2020. The results of this study estimated that the number of IoT devices connected to the internet is more than 46 billion up to 2020 [5].

Various researches have been conducted to increase the level of home security. Various researches have been conducted to increase the level of home security. The example of previous research is a prototype based on Arduino mega that is using a password to enter the house. The password is entered from keypad, a webcam is added to record the situation, and the PIR sensor detects movement as a trigger to activate LED lights at home. Wireless networks seem to be a suitable choice for the development of the IoT because they have the potential to overcome all challenges and IoT requirements themselves [5].

II. SYSTEM ARCHITECTURE

In this system, there is an integration of home security system devices using the internet for remote monitoring and notification that will be sent is an important consideration for choosing a home security system [6]. This system is using Wireless Motion Detection which is a small microcontroller that will be placed at the corner of the door and window. It will be integrated with several sensors that will detect the condition. Later, it reads the value of the sensor and then is sent through the network to the center. The station will turn on the alarm in the form of a buzzer and LED. After the reading results are received at the station, it will be forwarded to the cloud server which can take action on the input.

The microcontroller is used an ESP8266 NodeMCU SoC (System on a Chip) device as a node station and station [7]. ESP8266 NodeMCU has many advantages, such as an affordable price, small size, and small power [8]. Users can add their own modules and security functions also connect them to the internet [9-11].

This system uses an accelerometer and PIR sensor that will detect the acceleration of movement [12-13]. PIR sensors are suitable to sense movement. PIRs are basically made of a pyro-electric sensor which can be seen as the round metal can with a rectangular crystal in the center. It can detect levels of infrared radiation. All things emit some low level radiation. Hotter thing will emit more radiation. The sensor in a motion detector is actually split in two halves. If one half detects more or less IR radiation than the other, the output signal will turn

HIGH or LOW. They can detect whether a human or things has moved in or out of the sensors range which is around 30o.
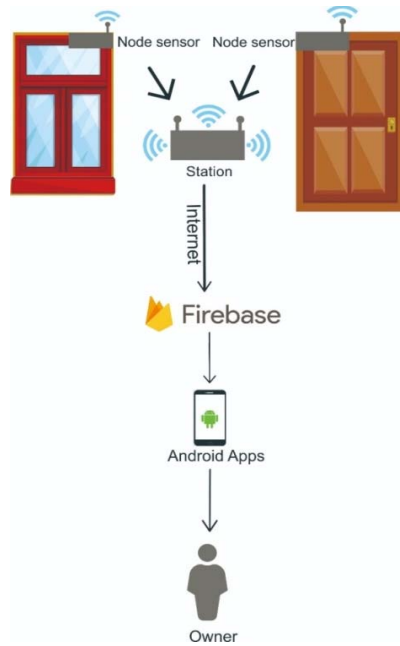

Fig. 1. Proposed System Architecture

They are small, reasonably priced, low-power and easy to use. For that reason they are commonly applied for gadgets used in homes or businesses [14].

The detected objects will be used as input of the system. The accelerometer and PIR sensors are connected to the microcontroller which is processing the data obtained by the sensor and transmit the condition to the central microcontroller [15]. The Most PIR modules have a 3-pin connection at the side or bottom. One pin will be ground, another will be output pin as signal to microcontroller and the final one will be power. Power is usually 3-5VDC input. When there is no movement, output pin will stay LOW. If sensor detects motion, the output pin will go HIGH to 3.3V. Then, the central microcontroller will respond to changes in these conditions by turning on the buzzer and also the LED light [16]. At the same time, the central microcontroller or station sends the value to the Adafruit IoT server which can be monitored and seen by the homeowner or users [17-19]. The IoT station sends data or pushes to the server for sending data to Google real-time firebase database. The data from sensor sent by this station will be stored in the database. Furthermore, Android application is built using Android studio that will retrieve data from the Firebase real-time database, so the android application can be monitored anytime
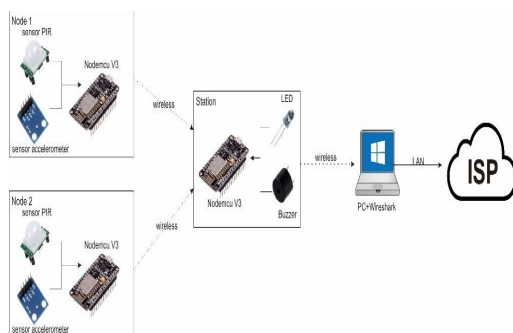

Fig. 2. Proposed Hardware Architecture

Fig. 3. Mobile-based notification when Window is moving

and anywhere in real-time. The following illustration of the system flow that occurs is in Fig. 1.

The topology used in this research uses wireless sensor network rules with the station device as the sender of data to Google firebase and Adafruit. Sensor nodes are located far apart from each other and using wireless for communication between nodes and stations. Sensor nodes are installed on windows or doors; besides that, they also can be installed on objects that are prone to be stolen such as safes. The sensors used in this system are PIR sensor and accelerometer. While at the station there is a LED and buzzer that will activate when getting data from the sensor node. The data sent to Google Firebase will be display on wireless motion detection applications on Android as displayed in Fig. 2.

Retrieval of data from this study is in the form of an android application that can monitor the conditions sent by the sensor. In addition, it also conducts experiments on whether the system is running well or not and can the sensor detect movement correctly and send it accurately.

III. Result

The results of this study are in the form of wireless motion detection applications on Android. This application can display real-time data from firebase. The firebase data comes from sent data by NodeMCU. Every changing condition from system will be detected as movement by PIR sensor.

The first detection comes from node that serves to monitor condition of the window. If the PIR sensor detects movement, output pin will set to HIGH then the wireless motion detection application will be changed as shown in the Fig. 3.

The second detected condition is from the PIR sensor installed on the window node to detect movement. Signal HIGH also will send through output pin. The previous display is "motion stopped", and then it will change to "motion detected". Fig.4 is shown the design for that condition.

The third condition is illustrated in Fig. 5 which the node sensor installed on the door. Almost the same as the first condition, if the GY-61 sensor detects a movement from the door, output will set to HIGH. It causes the initial display of "door is not moving" changes to "door is moving".

Fig. 4. Mobile-based notification when Window is not moving

Fig. 6. Mobile-based notification when Door is not moving

The last condition, if the PIR sensor on the node sensor installed on the door detects motion on the door. Output will go HIGH. The initial display which is "Motion Stopped" changes to "motion detected" when the sensor detects motion as can be seen in Fig. 6. The design is completed and implemented.

IV. CONCLUSION AND FUTURE WORK

In this work, the focus is on the design of mobile based application including the IoT architecture and information-based interaction for the industrial environments in Industry 4.0. In particular, a software-defined IoT architecture is designed to determine information exchange, and recommended possible solutions for software-defined IoT design.

This architecture design can be implemented since some innovative industrial applications can be realized through well-defined APIs. Also, the web design and provide
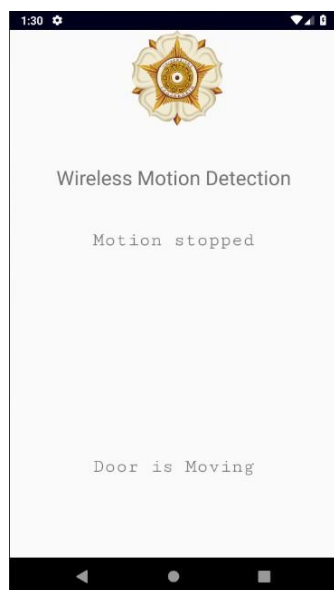
warnings to the user by email notification of this system can be developed to improve the system's performance and at the same time allow the provision of a wider range of services. This software-defined IoT design will support the evolution of Industry 4.0.

ACKNOWLEDGMENT

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Fig. 5. Mobile-based notification when Door is moving

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