FIRE AND SMOKE ALARM SYSTEM WITH SMS NOTIFICATION

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INTRODUCTION

Background of the Study

Fire is a serious problem that many countries around the world constantly deal with. Aside from casualties, it will have negative societal repercussions and cause property losses. China Commercial Fire and Safety Association reported that were a total of 233,000 fires registered nationally in 2019, resulting in 1,335 fatalities and 3.612 billion yuan in direct property losses. In comparison to 2018, there have been 4% fewer fires and 1.9% less property damage. Among these were electrical short circuits, aging, and other causes led to the majority of the fires (Xiong et al.,2019).

Currently, some businesses are utilizing internet of things technologies to improve safety and security. Similar with smart phone use, Arduino microcontrollers, and commercially accessible sensors like motion sensors or detectors.

One of the accidents encountered nowadays is the unintended fire burning to houses and even establishments which causes deaths and loss of properties. In the Philippines, this accident comes in the summer months, and sometimes this happens to squatter areas where houses are in a bit spacious.

Because of its geographical location, the Philippines is considered one of the most disaster-prone countries in the world, with catastrophic earthquakes, volcanic eruptions, tropical cyclones, floods, droughts, and fires. According to the reports, the devastation caused by natural disasters and hazards such as fires has increased in recent years, rising from approximately 50 per year in the early 2000s to 400 per year in 2019 (Dasig Jr., 2017). Fireworks are a significant source of fires, especially during the summer, Christmas, and New Year's holidays. As a result, these incidents stifle economic growth

by destroying social and physical capital, including infrastructure, necessitating the reallocation of ongoing programs to fund relief efforts for victims and residents, and reconstruction efforts that divert funds to social services.

To prevent and suppress the hazardous fire, uniform fire safety standards must be adopted, as well as the incorporation of fire safety, construction, and provision of protective and safety devices in buildings and structures (Dasig Jr., 2017). In a presidential declaration, a strategic plan for safety and security was defined as "one of the best available concept, design, material, system, and technology to provide a responsive, effective, and supportive intelligent environment for achieving the occupants' objectives over the full life-span of the building and properties." Compared to a conventional fire alarm system, this design reduces energy consumption, maintenance, and service operation costs, improves security services, and increases building occupant satisfaction. Other advantages include adaptability to changing uses and technology, as well as dimensional changes in environmental performance. The purpose of this study was to design and develop a fire detection and intelligent alarm system for educational facilities classified by the Bureau of Fire Protection (Dasig Jr., 2017).

Meanwhile, some houses have embraced technology to strengthen their safety and security. Security cameras and fire alarms were installed. But many houses in the Philippines still do not have security facilities because of budget constraints. Because of that, they cannot afford to have any security in their houses. Richard Orquiola who is a resident of Barangay San Antonio, Narvacan, has been a victim of fire. Based on

the investigation initiated by the Narvacan Fire Station They don't have an idea where the fire came from said and they continue to investigate.

For this project, the development of a home fire alert is built based on an Arduino board as the main controller board that interacts with the GSM module which works in the communication part. The interaction is for the user to know the current situation in the house. This system works totally on wireless network communication as the GSM module is performed by sending an SMS to the user. The microcontroller inside the Arduino board is used as the mastermind of the circuit where it controls the circuit flows and execute all the decision as well. The GSM Module is responsible for the communication part of the circuit. It takes information from the Arduino on where to send information and what information needs to be sent. It uses a GSM SIM card for communication purposes. It is a modem that uses serial communication to interface with and needs Hayes-compatible AT commands for communicating with Arduino. the project codes. As soon as a fire is detected (temperature will hit a certain temperature limit) an SMS will be sent to the recipient's phone number from the SIM card inserted into the module for giving information to the user upon fire detection in the house (Mahzan et al., 2018).

With the advancement of human civilization, fire safety has been a prime concern. Fire hazards can be fatal and denigrating for industrial and household security, and also minatory for human life. The best way to reduce these losses is to respond to the emergency as quickly as possible. So, there comes the necessity of standalone autonomous fire detection systems. These systems render the works of quick detection, alarm notification, and sometimes initiation of fire extinguishing. The systems, equipped with smoke, temperature, and pyro-electric sensors can detect unfavorable

accidental situations, as it happens, and with the help of a processing unit can alert instantly for undertaking cautious measures. In these fatal situations, early detection and a faster alert will yield lesser losses of property and life.

The purpose of a fire and smoke alarm system is to detect the presence of fire, smoke, or other potentially dangerous conditions within a building or structure. These systems are designed to provide early warning to occupants and initiate appropriate emergency response actions to mitigate the risks associated with a fire.

All the purposes of a basic fire alarm system are accomplished by a series of inputs and outputs. The system inputs consist of fire detection devices and system monitoring devices that activate the control panel and the outputs are responsible for occupant notification and control functions associated with life safety.

A fire alarm system is used primarily to evacuate the premises in the event or occurrence of a fire condition and then secondarily to report the fire to the proper authorities, in this paper a low-cost fire detection and control system based on smoke and heat detection is proposed. The use of wireless automation in almost all the fields of power, gas, agriculture, and security systems has over the years provided novel solutions to remote operations, in the paper the implementation of an SMS-based communication system is incorporated into a smoke detection system in the case of a fire. The implemented design is cheap and effective. The SMS-sending feature included in the design increases the reliability of the system. The design has been developed since the social and economic cost of natural disasters has increased in recent years due to population growth, changes in land use patterns, migration and unplanned urbanization, environmental degradation, and global climate change. Foreconsidered as being natural or manmade, thus the management shall provide safety for the building

occupant and properties. The system has come to light through the way of inspiration to develop a compact system, based on the fundamental ideas of safety, security, and control (Nuam Man et al., 2019).

Several fire alarm systems were proposed like the "Nest Protect" which is a smart fire alarm device, it could function as a single stand-alone device, with smoke and carbon monoxide detectors. Nest produces an alarm sound and sends a notification to the users when a fire is detected. It could also communicate with other "Nest Protect" smoke detectors – if they were available. In addition to that, users are alerted when the power of the device is low. Using the "Nest Protect" application, users can control the Nest detector remotely. The system is dedicated to detecting fire and notifying the concerned parties. Although these systems are similar to the proposed edge computing-based fire alarm system, they do not offer all the features like viewing the status of the monitored area or the independence of an existing home router. The system is composed of various separated nodes that communicate with each other when externally activated-either by the request of the user or by a fire- and this system's gateway is a single centralized node. The nodes connect via their Wi-Fi antennas within the network, without the need for a home router. Existing sensed parameters can be retrieved by users as well. The solution proposed is wireless, making it easy to install. The system is also scalable since it is easy to expand the number of covered rooms by adding more sensing nodes. Our system is reliable as well as it notifies the user whenever a sensing node goes down (Shoker, 2017).

A fire alarm system is used in properties to make them safe from fire. It can be designed in many ways with different components. Many expensive buildings must have fire alarm systems. In the market, almost systems are indoor systems. The indoor

systems can be known only to the person who is inside the building. Thus, this paper was focused on the design and implementation of knowing the fire status from remote. This proposed system designed has two sensors. One is the smoke sensor and the other is the smoke sensor. If these sensors sense the required amount of temperature and smoke, they send SMS to dedicated mobile use and alarm system to know the remote person and indoor persons (Nuam Man et al., 2019). A fire and smoke alarm system with SMS notification is designed to alert individuals of a potential fire or smoke hazard in a building or area. It consists of smoke detectors, fire alarms, and a communication module capable of sending SMS (text) messages to designated phone numbers when a fire or smoke event is detected.

In the literature, some research works proposed enhancing the existing fire alarm systems by improving the design of the fire control panel which is used by the fire department. For instance, the system developed by Radhi is a wireless fire alarm system. The sensors sense the occurrence of fire, then a signal is transmitted to a local server via Wi-Fi. The server -located within the firefighting center- will notify the administrators and display the location of the fire. Yet, the drawback of this system is that the locations must be preconfigured. Similarly, Ashwitha et al. developed a GSM-based fire alarm system described. The proposed system adds the feature of notifying the owner when a fire is detected. Their system is a wireless sensor network and it used N-F-N gateway which is an intelligent gateway interface for fire monitoring. The solution reduces hardware components and the cost of fire panels but setting it up requires multiple steps and may be inconvenient (Ali Radhi, 2017).
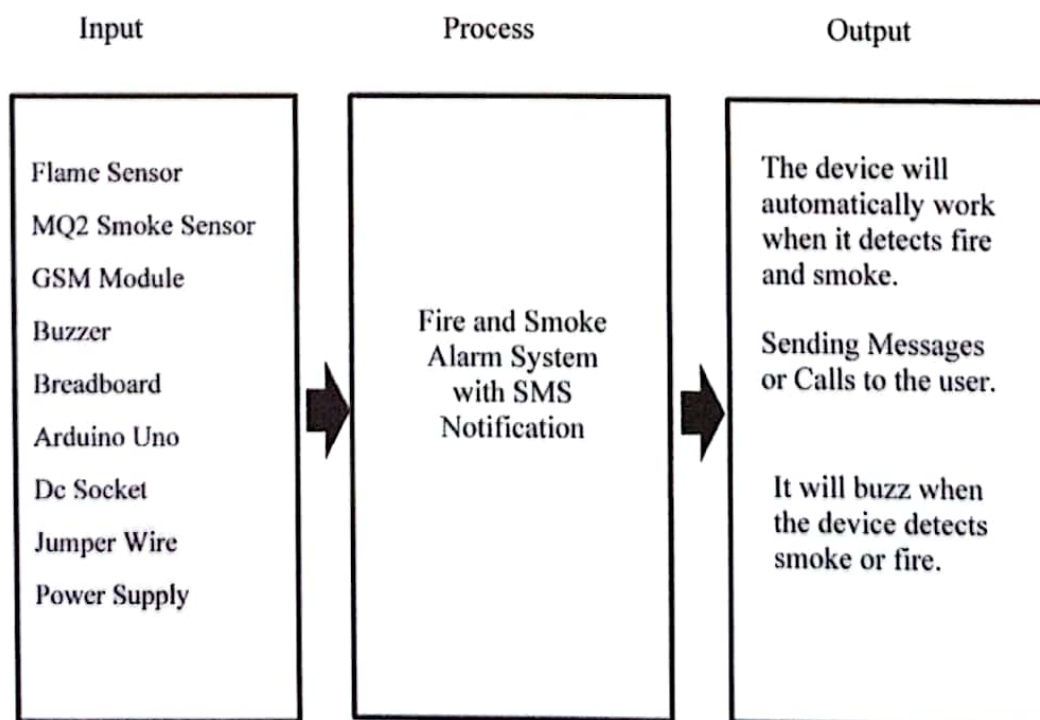
It's important to note that the specific implementation and features of a fire and smoke alarm system with SMS notification may vary depending on the manufacturer and the level of sophistication required. Some systems may offer additional functionalities, such as integration with a centralized monitoring station or the ability to control the system remotely through a dedicated mobile application or web interface.

With this, the researcher decides to conduct research on Smoke and Fire Alarm Systems with SMS Notifications. A system that may use by everyone in the community to secure their house and establishments from incidents concerning fire.

Conceptual Framework of the Study

Figure 1 shows the conceptual framework of the study. It served as the outline of how the researchers conducted the study.

Input	Process	Output
Flame Sensor MQ2 Smoke Sensor GSM Module Buzzer Breadboard Arduino Uno Dc Socket Jumper Wire Power Supply	Fire and Smoke Alarm System with SMS Notification	The device will automatically work when it detects fire and smoke. Sending Messages or Calls to the user. It will buzz when the device detects smoke or fire.

Figure 1. Conceptual Framework of the Study

The Input-Process-Output (IPO) diagram (see Fig. 1) was used to visually illustrate the context of this study. In Input, the existing materials are the Arduino Uno, Flame Sensor, MQ2 Smoke Sensor, GSM Module, Buzzer, Breadboard, Dc Socket, Jumper Wire and Power Supply. In the Process, this is the device that we made Fire and Smoke Alarm System with SMS Notification. And the Output, those are the feedback of our device that the researcher's developed.

Objectives of the Study

This study generally aimed to design a smoke and fire alarm system with an SMS notification prototype with the integration of the Internet of Things (IoT). In specific, the study sought to explore the following:

1. To determine the current situation of fire detection in Barangay Silag, Sta. Maria, Ilocos Sur.

2. To determine the materials and components needed to design and develop a prototype for a Smoke and Fire alarm system with SMS Notification.

3. To evaluate the level of acceptability of the developed prototype.

Scope and Limitation of the Study

This Smoke and Fire Alarm System with SMS Notification uses sensors to detect smoke and fire. It also includes a GSM module which is the SIM800L which allows the system to notify the users through SMS. The system focuses only on SMS notifications. It doesn't have a web interface because the main concept is only to notify the user if a certain fire or smoke is being detected.

Importance of the Study

The fire alarm system with notification via SMS was mainly created for the school building, houses, and offices. This technology would alarm people inside a vicinity beforehand, or even achieve excellent prevention, or even achieve excellent prevention of fire before it even starts.

The **System Users** could provide beneficiaries with one of the best alarms that can alarm school buildings, houses, and offices and send a push notification via SMS to the users that a fire might start when triggered. If there is an

immediate threat to life, property, or the mission, the fire alarm system will sound the alarm and send a message to the user, warning occupants to leave and notifying authorities that they must respond so they have time to escape.

The **Bureau of Fire Protection (BFP)** could help them in their job. The system will help them control different fire occurrences. They can rescue automatically because the user can call or text the BFP immediately.

The **Research** could use this as an instrument to broaden their understanding and improve their skills, specially creating a new device using similar development approaches.

The **Future Researchers** could help future researchers build up and recreate the system with innovation and can assist them with the design of a fire alarm system with notification via SMS and Arduino Uno microprocessor. They can also improve their learning about IoT, and also to improve the features of the said device or system. This document can serve as a reference and guide for researchers who would create similar systems for school buildings and houses. This research will serve to create as their stepping-stone toward their brightest goal.

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Chapter 2
METHODOLOGY

This chapter outlines the process followed in gathering the data and doing the analysis that was important to the study. The study research design, software model, population and locale, research instrument, and data analysis tools are all discussed. It also provides information about who the respondents are, and how they were sampled for the research.

Research Design

The study employed both descriptive-developmental research design to provide and collect the required data upon conducting the study. This research approach helped the researcher reach the study's objective. According to Fox and Bayat (2007), the objective of the descriptive research approach is to provide new information that aids in comprehending current difficulties or problems while also providing a more detailed description of the situation. Establishing the procedure through which the researcher will get the data for the study is the goal of the developmental research design. It makes decisions regarding what data will be gathered and how it will be gathered. The threshold for sensors that detect flame and smoke was determined by this researcher using the descriptive research strategy based on the sensor specifications.

Software Model

This study presents the Software Model used in the project. This research demonstrates the use of the Prototyping Model. This model is a life-cycle model used by the researchers to build, tests, and reworked until an acceptable prototype is achieved for a Fire and Smoke Alarm System with SMS Notification for buildings, houses and

rooms that are prone to fire. It also creates bases to produce the final system or software. It works best in scenarios where the project's requirements are not known in detail.

The prototyping Model is divided into six major phases that are carried out cyclically By following these six phases in a cyclic manner, the prototype evolves and matures over time. Each cycle allows for feedback, learning, and incremental improvements, ensuring that the final product meets the desired objectives effectively.

It's important to note that the prototyping model can be adapted and customized based on the specific needs of the project and the nature of the system being developed. The emphasis is on rapid iterations, continuous feedback, and progressive refinement to create a high-quality solution that fulfills stakeholder expectations.
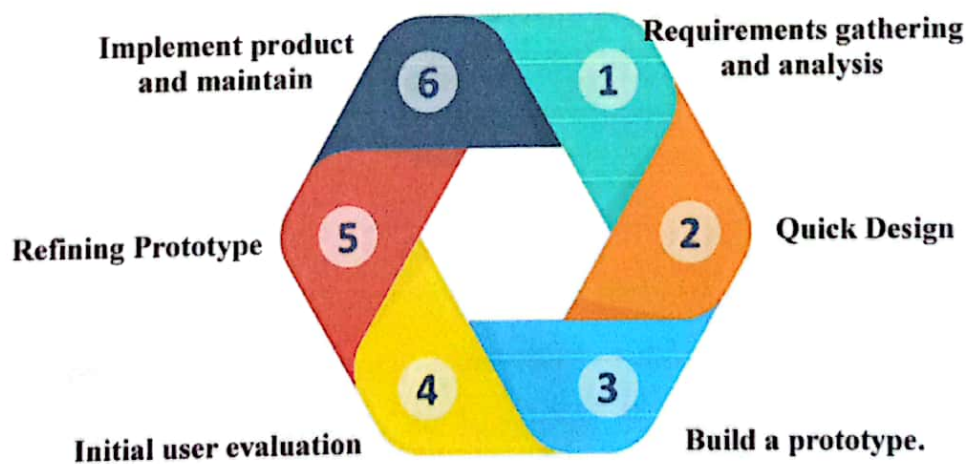
Figure 2. Prototyping Model

Requirements gathering and analysis. A prototyping model starts with requirements analysis. In this phase, the requirements of the development are defined in detail. During the process, the users of the device are interviewed about the development of the project to know what is their expectation from the project.

Quick Design. The second phase is the preliminary design or quick design. In this stage, a simple design of the device is created. However, it is not a complete design. It

gives a brief idea of the project to the user. The quick design helps in developing the prototype.

Build a prototype. In this phase, an actual prototype is designed based on the information gathered from quick design. It is a small working model of the required system.
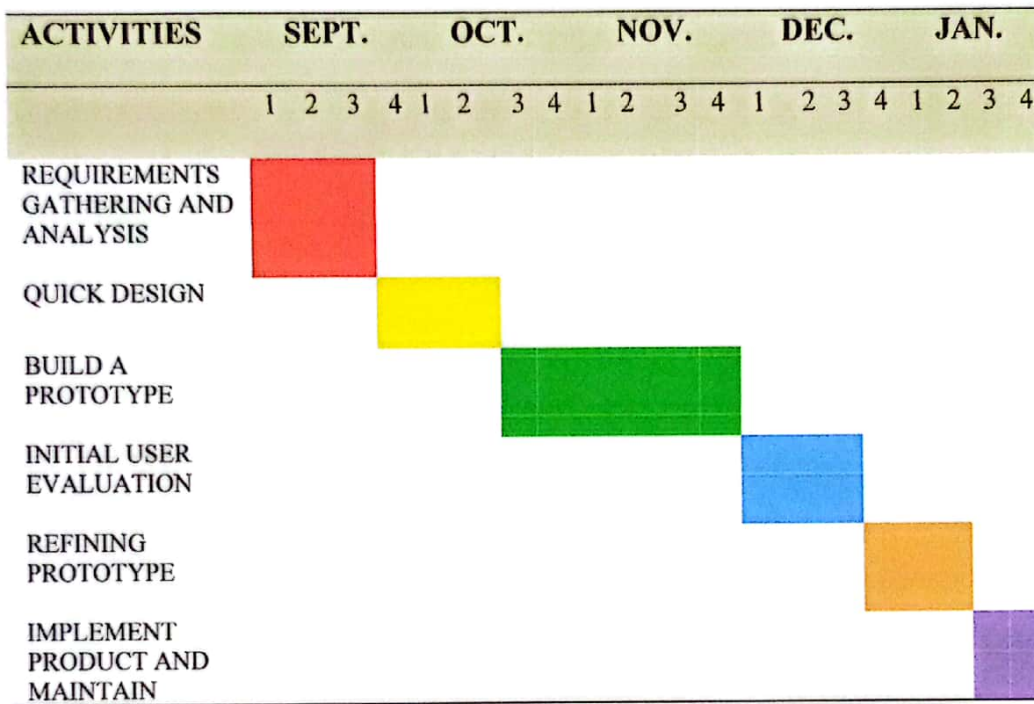
Initial user evaluation. In this stage, the proposed device is presented to the client for an initial evaluation and to show them the development of our project. It helps to find out the strength and weaknesses of the working model. Comments and suggestions are collected from the customer and provided to the developer.

Refining Prototype. If the user is not happy with the current prototype, you need to refine the prototype according to the user's feedback and suggestions. This phase will not be over until all the requirements specified by the user are met. Once the user is satisfied with the developed prototype, a final device is developed based on the approved final prototype.

Implement product and maintain. Once the final device is developed based on the final prototype, it is thoroughly tested and deployed to production. The device undergoes routine maintenance for minimizing downtime and prevent large-scale failures.

Project Plan

Table 1 presented the methods and procedures that were use to collect information required to clearly illustrate the status of the development of the Fire and Smoke Alarm System with SMS Notification, which could lessen the burden on the managers. It also shows the pattern and time frame for each of the six phases of the prototyping model.

ACTIVITIES	SEPT.				OCT.				NOV.				DEC.				JAN.			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
REQUIREMENTS GATHERING AND ANALYSIS	█	█	█																	
QUICK DESIGN				█	█															
BUILD A PROTOTYPE						█	█	█												
INITIAL USER EVALUATION									█	█	█									
REFINING PROTOTYPE												█	█	█						
IMPLEMENT PRODUCT AND MAINTAIN															█	█				

Table 1. The cycle of the methods and procedures applied in the study

Project Assignments

The table shows that each member has different tasks and responsibilities in the development of the system. The leader provides and gives assignments to his members according to the skills they have and helps build cooperative teamwork. The leader would not only designate tasks but must work also accordingly. Members are grouped to be the project developer, documentation developer, and review team. Furthermore, each of the staff needs to meet the goals and requirements needed with specific due or time.

These project assignments cover different aspects of developing a fire and smoke alarm system with SMS notification and offer opportunities to explore various areas such as system design, programming, testing, user experience, compliance, and documentation. Choose an assignment that aligns with your interests and expertise or

combine multiple assignments to create a comprehensive project.

The role requirement and responsibilities of the members can be seen in Table 2.

ROLE	FUNCTION/S	PERSON'S INVOLVED
Project Leader	Lead team, report status Review deliverables and assure quality	Charlie B. Baclle
Documenter	Create content	Anjenette Draculan Charlie B. Baclle
Planner and Designer	Design the prototype	Charlie Baclle Arturo F. Enriquez Jowen Spencer V. Sotto
Review Team	Build the prototype Evaluate deliverables and promote of use	John Mark P. Sipin Jayson Cabacungan Arturo F. Enriquez

Table 2. Role Requirements and Responsibility

Population and Locale of the Study

The researchers decided to conduct the study on Fire and Smoke Alarm Systems with SMS Notification at Barangay Silag, Sta. Maria, Ilocos Sur. Three (3) barangay officials and seventeen (17) residents/homeowners are the respondents of the study.

Respondents	No. of Respondents
1. Barangay Officials	3
2. Residents/ Home Owners	17
Total	**20**

Table 3. Distribution of Respondents

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Research Instruments

Interview, documentary analysis, internet research/library research, and survey questionnaire were the tools that are used in the study, which also involved the participation of the selected residents of Barangay Silag, Sta. Maria, Ilocos Sur

TAM (Technology Acceptance Model) is the most influential model of technology acceptance, with two primary factors influencing an individual's intention to use new technology (Davis,1989). The researchers utilized this model in determining the acceptability level of the designed system.

Data Analysis

The floated interview questions from the respondents were analyzed by the researchers. They collected the data to see and plan if the locality needs a Fire Alarm System with SMS Notification and on the possible features of the said project. To interpret the results under objective number 3, the data-gathering tools and statistical treatment were utilized. Table 4 shows the descriptive interpretation of the proposed system's level of acceptability.

Point Value	Mean Range	Descriptive Rating	Descriptive Interpretation
5	4.21-5.00	Strongly Agree	Very Highly Acceptable
4	3.41-4.20	Agree	Highly Acceptable
3	2.61-3.40	Neither Agree	Moderately Acceptable
2	1.81-2.60	Disagree	Slightly Acceptable
1	1.00-1.80	Strongly Disagree	Not Acceptable

Table 4. Descriptive Interpretation on the Level of Acceptability

A scale from Not Acceptable to Very High Acceptable was use to rate the information that was gathered. In terms of interpretation, a mean score of 1.00-1.80 indicates a Strong Disagreement and is interpreted as Not Acceptable, 1.81-2.60 indicates a Disagreement and is interpreted as Slightly Acceptable, 2.61-3.40 indicates a lack of Agreement and is interpreted as Moderately Acceptable, 3.41-4.20 indicates Agreement and is interpreted as Highly Acceptable, and 4.21-5.00 indicates a Strong Agreement and is interpreted as Very High Acceptable.

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