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Bluetooth Piconet System for Child Care Applications

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***Abstract*—**This study mainly concerns a safety device designed for child care. When children are out of sight or the caregivers cannot always pay attention to the situation, through the functions of this device, caregivers can immediately be informed to make sure that the children do not get lost or hurt, and thus, ensure their safety. Starting from this concept, a device is produced based on the relatively low-cost Bluetooth piconet system and a three-axis gyroscope sensor. This device can transmit data to a mobile phone app through Bluetooth, in order that the user can learn the situation at any time. By simply clipping the device in a pocket or on the waist, after switching on/starting the device, it will send data to the phone to detect the child's fall and distance. Once the child is beyond the angle or distance set by the app, it will issue a warning to inform the phone owner.

***Keywords*—**Children care, piconet system, three-axis gyroscope, distance detection, falls detection

I. Introduction

IN today's society, caregivers often go to food markets or department stores with the children in their care, and during shopping, or accidentally, the children can become lost, fall, or move out of sight; this situation can cause a sense of nervousness and fear for caregivers. To address the aforementioned situation, the proposed system would not only warn the caregiver when children are a dangerous situation, but also indicate which one is missing, if the caregiver is using one to multiple mode. Once the app [1] finds that children go too far, fall, or do dangerous jumps, etc., it will issue a warning to inform the user.

II. System Architecture

This product is a multi-functional Bluetooth control system, which is produced by a one-to-three Bluetooth piconet system warning device mainly designed for child care, and monitored by a mobile app, with various functions, including safe distance, and warnings for dangerous jumps and falls. The system architecture is as follows: the signal detector sends the data to the microprocessor of the sub-machine, and this data are transmitted through the Bluetooth interface to the microprocessor of the mother machine, which then sends the data to the phone via the Bluetooth interface. A buzzer serves as the alarm system, and the system includes a call function, meaning the caregiver can call the care-receiver through the phone. The diagram of the system architecture is shown in Fig. 1.

The operational core of the system sensor is a three-axis gyroscope (MPU-6050) with the functions of a gyroscope and acceleration [2], [3], which uses the principle of the gyroscope, and angle changes are reflected by the floating number, which is used for distance detection, fall detection, and door and window change detection. The three-axis gyroscope is a device that detects and maintains direction, and its design is based on the law of the conservation of angular momentum. The three-axis gyroscope consists of a wheel that can be rotated on its axis. When the three-axis gyroscope starts to rotate, it has the tendency to resist the change of the direction due to the angular momentum of the wheel. The gyroscope is usually used in the navigation, positioning, and pedometer systems.
The operation principle is shown in Fig. 2.

The results of this study focus on the safety device, with the three-axis gyroscope as the main axis, and extends to include five functions, abnormal jumps sensing, distance sensing, anti-fall sensing, call, and alarm. The diagram of the overall system functions is shown in Fig. 3.

III. System Functions

The main body of the system is not based on the expensive main mobile phone system, but on the less expensive Bluetooth piconet system, of which the micro-controller is Arduino, and the operating system includes the mother machine and the sub-machine. The sub-machine is a sub-processor, and is responsible for the operation of the three-axis gyroscope, which sends the data to the mother machine; while the mother machine serves as the main processor, which is responsible for receiving the data sent from the sub-machine to the app [4], [5]. The operation principles are shown in Figs. 4 and 5.

A. Distance Warning

In order to keep children and elderly people in sight when going out, the system uses the principle of a three-axis gyroscope calculator, where the sub-machine calculates the distance. When the sub-machine is beyond the app terminal setting distance [6], the mother machine will send the data through the Bluetooth to the mobile terminal to determine whether to issue an alarm [7]. The operational logic is shown in Fig. 6.

B. Falls Warning

In order to ensure that an accidental fall of a child will set off an alarm, the three-axis gyroscope of the system detects the X axis and Y axis. When the sub-machine's tilt angle is beyond the safety angle set by the terminal, the mother machine will send the data via Bluetooth to the terminal to determine whether to issue an alarm. The logic of the operation is shown in Fig. 7.

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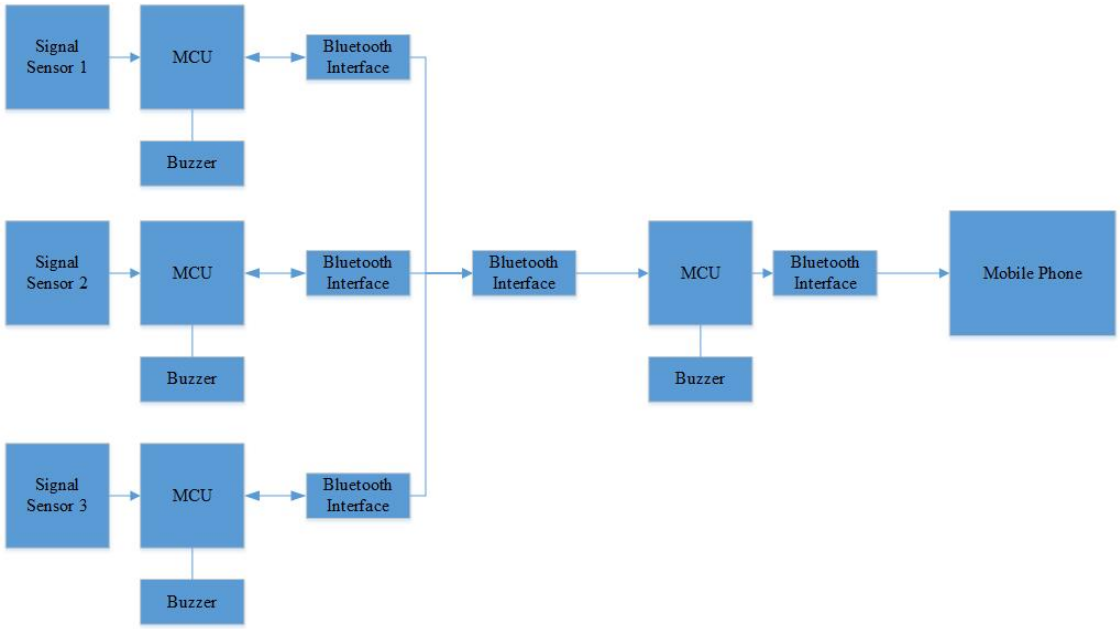

Fig. 1 Diagram of the System Architecture

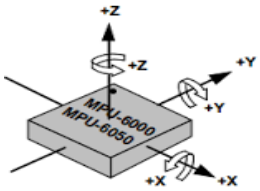

Fig. 2 Diagram of the Three-axis Gyroscope Principle

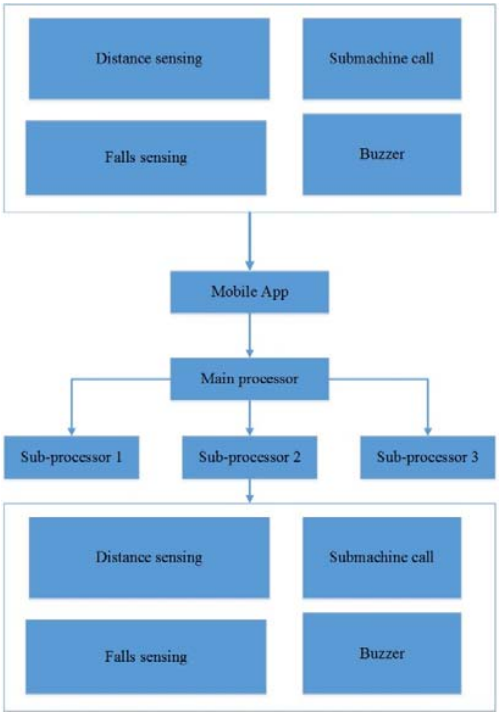

Fig. 3 Diagram of the Overall System Functions

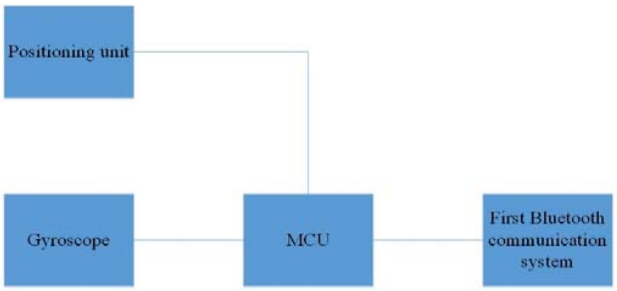

Fig. 4 Diagram of the Sub-Machine Operation Principle

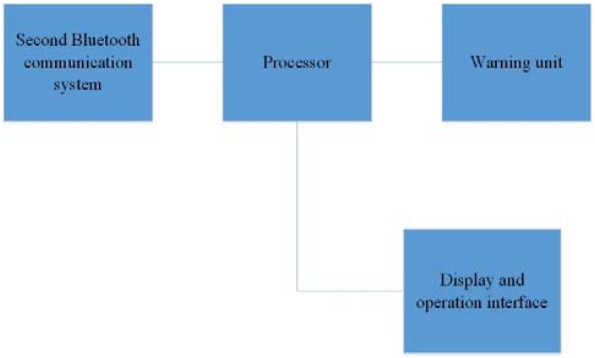

Fig. 5 Diagram of the Mother Machine Operation Principle

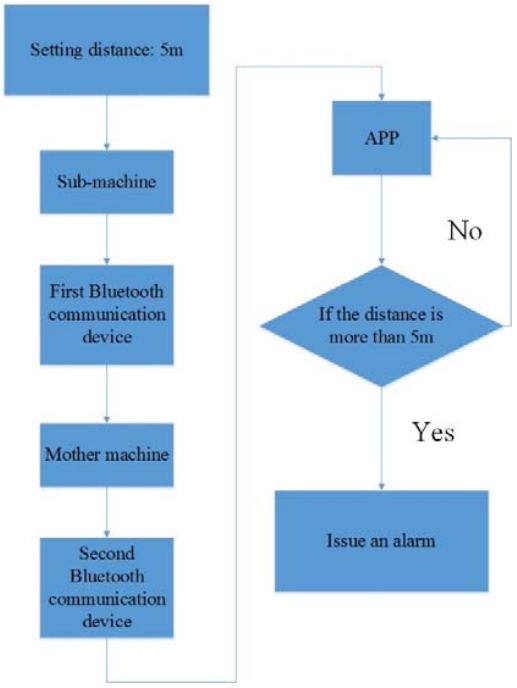

Fig. 6 Logic Flow Chart of Distance Warning

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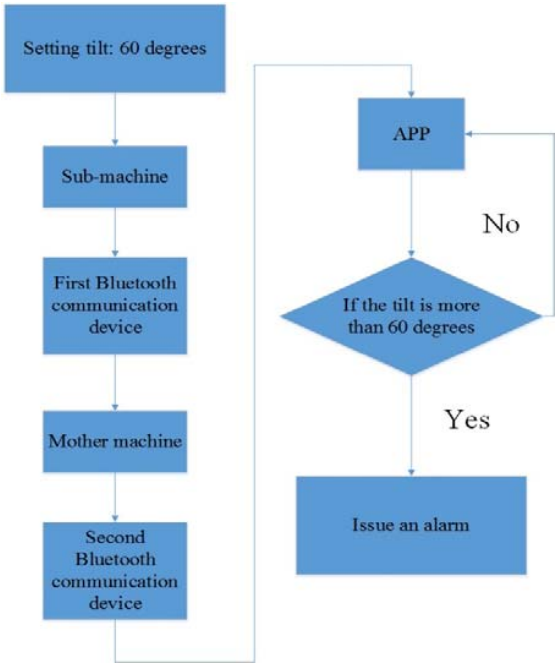

Fig. 7 Logic Flow Chart of Fall Warnings

C.Abnormal Jumps Warning

In order to prevent children from doing dangerous jumps, the system uses a three-axis gyroscope to detect gravity values. When the sub-machine determines dangerous jumping actions, the data are sent to the mother machine, which will then transmit the data to the mobile phone app [8], [9] via Bluetooth to determine whether an alarm should be issued. The logic of the operation is shown in Fig. 8.

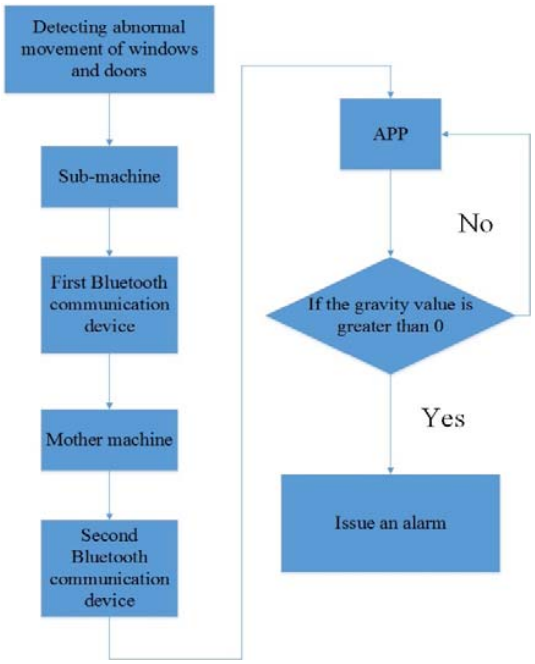

Fig. 8 Logic Flow Chart of Abnormal Jump Warnings

D.Call

In order to facilitate the connection between the caregiver and the care-receiver, through the two-way characteristics of Bluetooth, the system uses the button of the sub-machine device and the mobile APP. The button of the sub-machine calls the mobile APP, and the mobile APP calls all the sub-machine terminals. The logic flow chart is shown in Fig. 9.

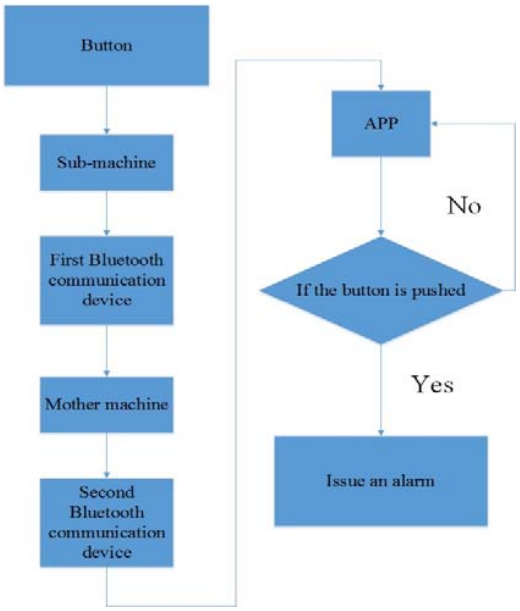

Fig. 9 Logic Flow Chart of Call

IV. System Planning and Design

The user can learn the operation of each sub-machine through the mobile app, and the design of the app interface displays the numbers by text, which allows the user to know the changes in values. A sensing function is added to the app interface, which includes abnormal jumps sensing, call, Bluetooth connection, and displays the changing values of the three-axis gyroscope. The diagram of the app is shown in Fig. 10.

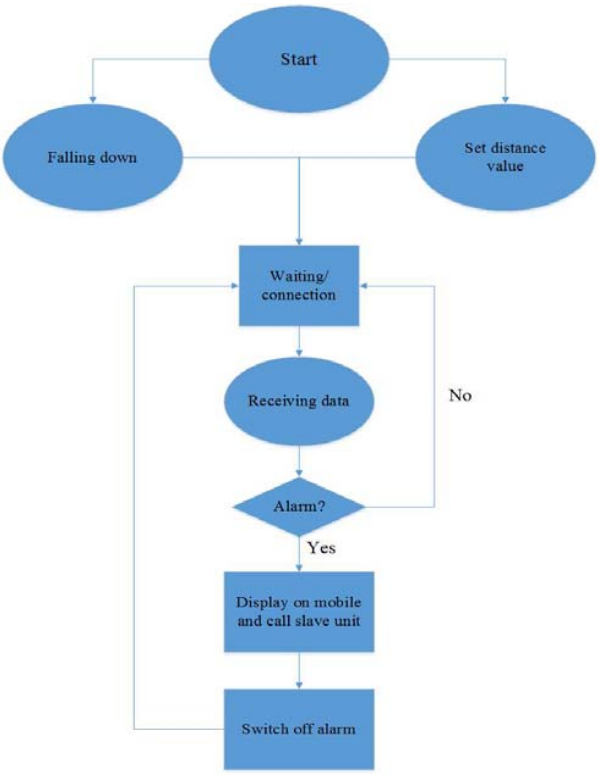

Fig. 10 Logic Flow Chart of the App

V. Conclusion

This study mainly focuses on Arduino and the application of Bluetooth one-to-many wireless transmission, and takes child care as the topic of study, which helps improve safety issues for personal care. The study uses the Bluetooth one-to-many microgrid system, three Axis gyroscopes, and a buzzer, and selects Arduino and Android as the operating system. Through continuous correction and testing, this study effectively integrates software and hardware. Follow-up studies can focus on diversity and size problems, as the purpose of applying the results of this study into a product is to function effectively and make a contribution to child care.

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