WALKING STICK WITH INTELLIGENT CONTROL SYSTEM

Khin Mar Win[1], Hla Htay Win[2] & Khin Khin Myo[3]

Abstract

Awalking stick with intelligent control system is designed and constructedfor the purpose to help the blind persons. The system is capable of avoiding any obstacle in the way for a blind person. The system operates by combination of the function of hardware and firmware. The hardware of the system consists of the ultrasonic motion sensor HC-SR04module, the light sensor (LDR), the water sensor module and buzzer. The ARDUINO MEGA 2560 development board is used to control all sensors' operationsand gives an output alert for each sensor to the blind person. Besides, the system is contributed by GPS (Global Positioning System) and GSM (Global System for Mobile communication). The control program is written in C programming language. Furthermore, someone can find out the position of that walking stick because of the GPS and GSM facility.

Keywords: ARDUINO MEGA 2560, ultrasonic motion sensor, water sensor, GPS, GSM, C programming language, blind person

Introduction

According to the World Health Organization (WHO) statistics, around 30 billion people are blind on the earth [Aras, (2012)]. This research proposes to design and develop a portable unit (stick) for the blind person for easy usage and navigation in public places. Blind stick is an innovative stick designed for visually disabled people for improved navigation. The generally available blind walking sticks are capable of finding obstacle that touches the stick physically. It is helpful to a blind person that allows sensing objects before stick touches them. A smart stick includes GPS tracking feature which will have SD memory card which used to store different locations and to find lost person along with other useful features [Gaurav, (2017)].

The constructed system proposed an advanced blind stick that allows visually challenged people to navigate with ease by using advanced technology. It uses ARDUINO MEGA 2560 based circuit to handle the entire system functioning. The system uses an ultrasonic sensor to sense and detect

1. Dr, Lecturer, Department of Physics, Meiktila University
2. Dr, Lecturer, Department of Physics, University of Yangon
3. MRes Student, Department of Physics, University of Yangon

obstacles/objects that ahead using ultrasonic waves within certain range of the person. On sensing obstacles, the sensor passes data to the ARDUINO. The ARDUINO then processes this data and calculates if the obstacle is close enough. If the obstacle is not close to sensing stick, the sensor circuit will not give any response. If the obstacle is close to the sensing stick, the ARDUINO sends a signal to sound a buzzer.

Also, the system uses a shorting system to detect and check if there is water in front of the sensing stick. As soon as the water sensor is wet, that system signals the blind person by a beep pattern. Besides, the system also has a light sensing feature to give the blind person a sense of light. It signals the person if there is light or darkness so that he/she can know if it is night or would enter a very dark room/facility. In addition to the system has one more advanced feature integrated to help the blind person if they forget where they kept the blind stick. If the person looses the stick they can use the GPS system by calling the mobile phone and when the user called the mobile which will send the location of the stick. This system will send the message which can see the location of it at the Google map link thus the blind person able to find the lost stick. Thus, this system allows for obstacle detection as well as finding stick if misplaced by visually disabled person. The block diagram of the constructed system with GPS and GSM are shown in Figure (1).

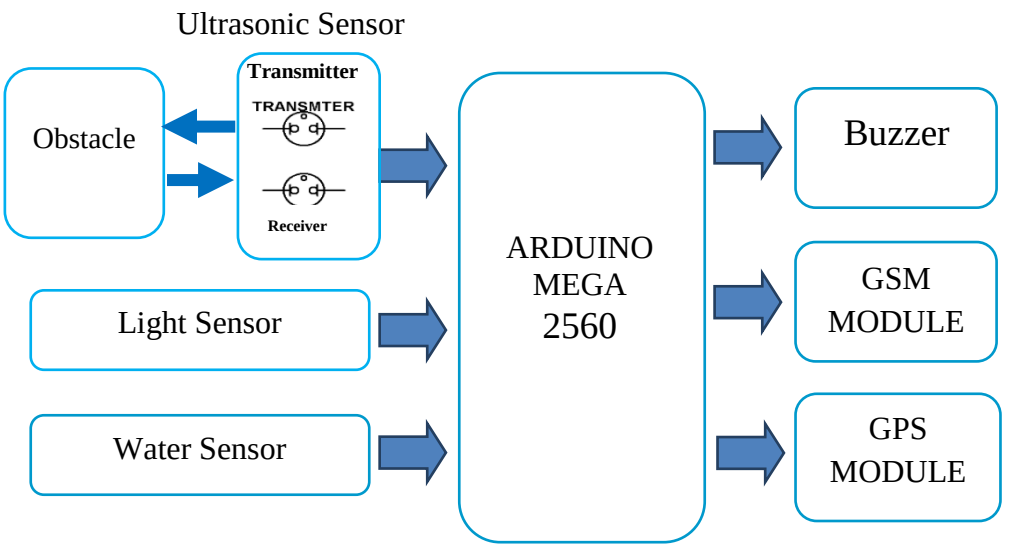


Figure 1: The block diagram of walking stick with intelligent control system

Methodology of the System

Design and Construction of the System

This circuit is based on ARDUINO MEGA 2560 which is quite compact and it is connected with the ultrasonic sensor, water sensor, GSM module and GPS module. The main objective is to help visually challenged people to navigate with ease using advance technology. In this constructed system, the circuit construction can be divided into two parts, the circuit work and programming. The circuit work is completed by fitting the components on the self-designed printed circuit board. The program is written in C programming language. The photograph of the ultrasonic sensor, water sensor, GSM module and GPS module are shown in Figure (2-4).

Circuit Design and Connection between ARDUINO and Sensor Units

The circuit is designed by computer aided software on the personal computer (PC). In this circuit diagram, the two analog pins of ARDUINO are used as input of two sensors and the digital pins of ARDUINO as output and input. The trigger (TX) pin of ultrasonic sensor is connected with digital output pin of ARDUINO (pin 10) and echo (RX) pin of sensor is joined with digital pin of ARDUINO (pin 11). A 5V pin of it is communicated with Vcc pin of sensor and GND pin is connected to GND pin of sensor. In this circuit, abuzzer is used as output for all sensors and an LED is used to indicate for farthest distance for motion sensor. The two resistors 330Ω are connected between each of LED, buzzer pin and GND pin of ARDUINO. The output pins of sensor are joined to digital output pin 12, 13 of ARDUINO. This sensor has the distance limitation, if the obstacle distance is less than 6cm the buzzer is ON state and during this condition the LED is OFF state. If the distance between sensor and obstacle is greater than 6cm the LED is ON state at this time the buzzer is OFF state.

The light sensor has two connectors; the first one is connected to 5V pin of ARDUINO. And then the analog input (pin A0) pin of ARDUINO is joined between the other pin of LDR and the resistor 330Ω. The digital (pin 7) of ARDUINO is used as output for sensor and it is connected with LED and resistor. The other remain side of each resistor are joined to GND. The GSM module is used for this sensor to send message to the user form stick. The five

pins of GSM module are used for output which is TXD, RXD, GND, VCC and GND. When the GSM module is interfacing with ARDUINO, the transmit pins (RXD) and the receive pins (TXD) of GSM module and ARDUINO can be connected with each other in reverse manners. Because of the data of ARDUINIO transmit to GSM module and similarly transmitted data from GSM transmit pin (TXD) go to receive pin (RXD) receive pin of ARDUINO. This is a wired communication to send data from one device to another. There are many methods of wired communication but ARDUINO and GSM interfaced through two wire serial communication.

Serial communication means to send data bit by bit. There is one important to consider while using serial communication that is baud rate. Baud rate is the number of bits transfer per second from one device to another. So, the baud rate should check compatibility between two devices. Usually SIM900A GSM module support 9600 baud rates with Universal Asynchronous receiver and transmitter (UART) type serial communication. That is why the pin 9 and 8 of ARDUINO is defined as serial RXD receive and TXD transmit pins. The 5V power is applied to GSM's Vcc and ground pin of GSM module is joined to ground pin of ARDUINO. The next GND pin of GSM module is connected with GND pin of ARDUINO.

The operation of the sensor is if the dark shadow falls onto the Light Dependent Resistor (LDR) sensor, the indicator buzzer produces sound and after a few seconds a message ("Could you take me, it is so dark:") sends to the person at home. At the day time the LDR sensor does not show any sense. The objective of setting up the LDR sensor unit is to know day and night for the blind person especially for the night and this sensor help them to escape from the dangerous condition at night. In this sensor include four connectors which are analog (A_0), digital (D_0), GND and Vcc. Vcc pin is connected to the 5V power supply, GND pin is connected to the GND of ARDUINO, D0 pin is connected to a digital pin 6 and the A0 pin is connected to the analog output pin A1 of ARDUINO. The number of pin will base on the actual program code. After hardware connection, the control sketch is uploaded into the ARDUINO MEGA 2560 microcontroller by ARDUINO IDE. Using a USB cable, connect the ports from the ARDUINO MEGA 2560 to the computer and upload the program.

The GPS module has five connectors among them is used four pins for output. The RX pin and TX pin of module are connected with RX pin and TX pin of ARDUINO directly. The Vcc and GND pins are joined with ARDUINO. The PSS pin of GPS module is not used. The simulation of the circuit diagram on Trax Maker is shown in Figure (5). The circuit track lines of the both soldering side and components side of the stick is shown in Figure (6).

The buzzer is used as output in that sensor and the buzzer output is communicated to the digital output pin 5 of ARDUINO. If the water sensor gets wet, the buzzer is alarmed by a beep pattern and brush off the water on the sensor, the buzzer is not shown any more and it is restored to the initial state.

Etching PCB for Circuit Construction

The circuit is designed by using Trax Maker software to obtain a smart and efficient circuit work. Then it is printed on the paper and copied the printed circuit track-lines of carbon powders to the copper side of the circuit board by ironing. The ironing process last for 2 to 3 minutes until the printed paper firmly sticks to the copper side of the board. Then the board is immediately immersed in the water to remove the soaked papers.

After slowly and carefully removing the paper, the carbon track-lines of circuit lines are appeared on the board. Then the board is etched with a solution of ferric chloride which is the copper etching chemical. Slowly shaking in the ferric chloride solution removes the unwanted paper parts of the circuit board and obtains required circuit track-lines. This process took about 20 to 30 minutes, according to the concentration of the solution and the etching area of the circuit board. The larger the area of the board, the longer etching times it is taken.

After receiving the circuit track-lines, drill holes are made for component insertion. After drilling is finished, the board is washed with thinner for the carbon track-lines to obtain shiny copper track-lines. But the copper track-lines have to be cover with a petroleum based coating (polish) for protection of being copper-oxide. After finishing the circuit design work, the circuit is simulated several times until getting the optimum condition. This

optimum circuit design is drove on the printed circuit board PCB and the circuit components is mounted at their places on this PCB. After soldering the circuit on the printed circuit board, check on soldering points for short circuit and orientation of the components. If everything is correct, the circuit is ready for test. The components side and soldering side of the printed circuit board is shown in Figure (7).

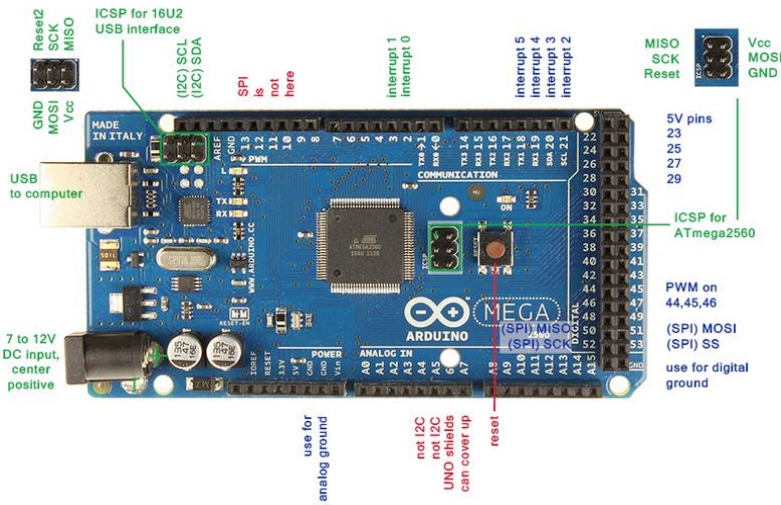


Figure 2: The pin configurations of ARDUINO MEGA 2560

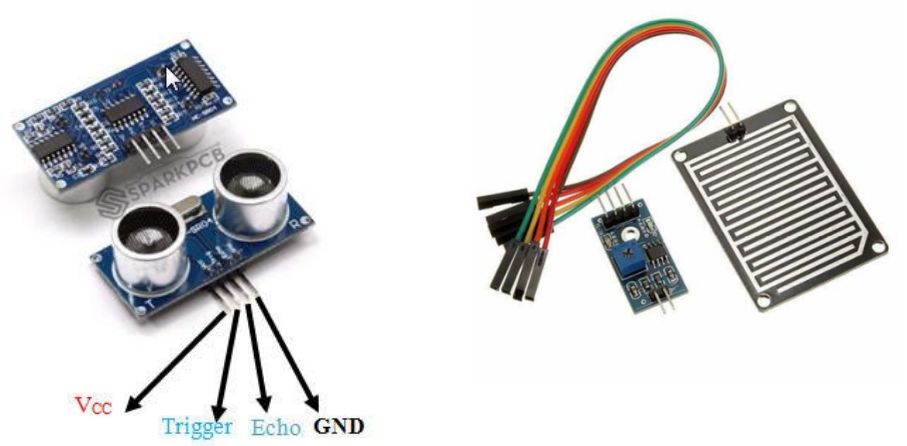


Figure 3: The photograph of Ultrasonic sensor and water sensor

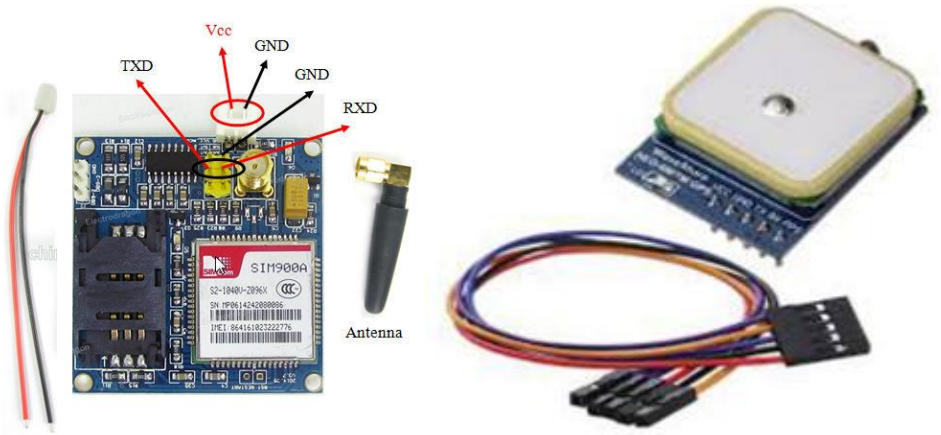


Figure 4: The photograph of GSM module and GPS module

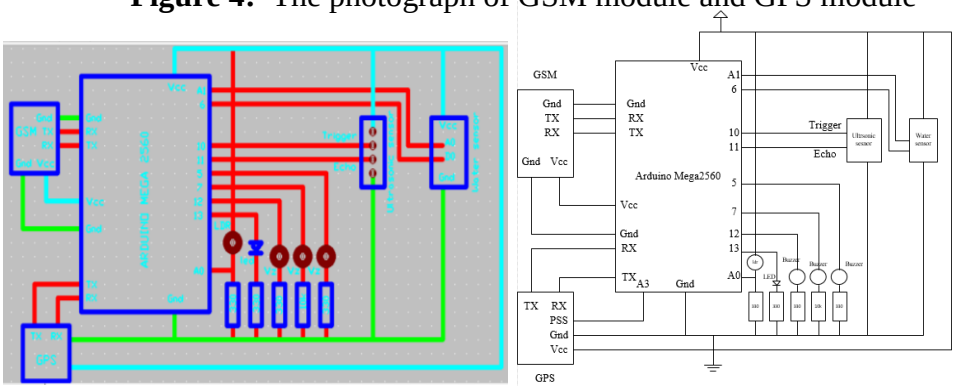


Figure 5: The simulation of the circuit on TraxMaker and complete circuit diagram of the whole system

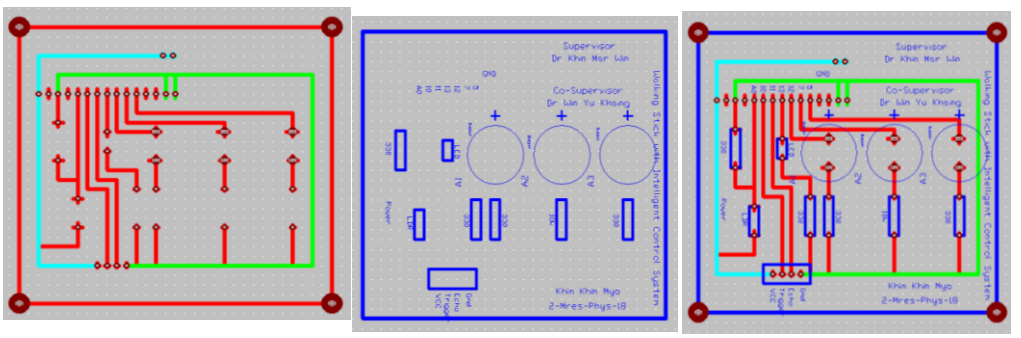


Figure 6: The circuit track line diagram of the blind stick in solder side, components side and both solder and components side

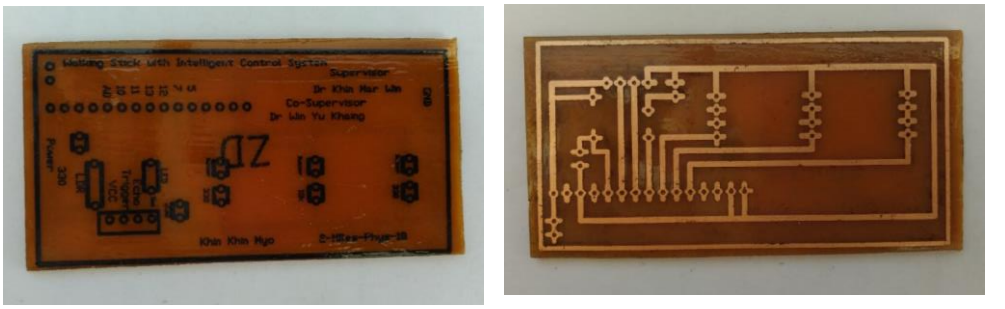
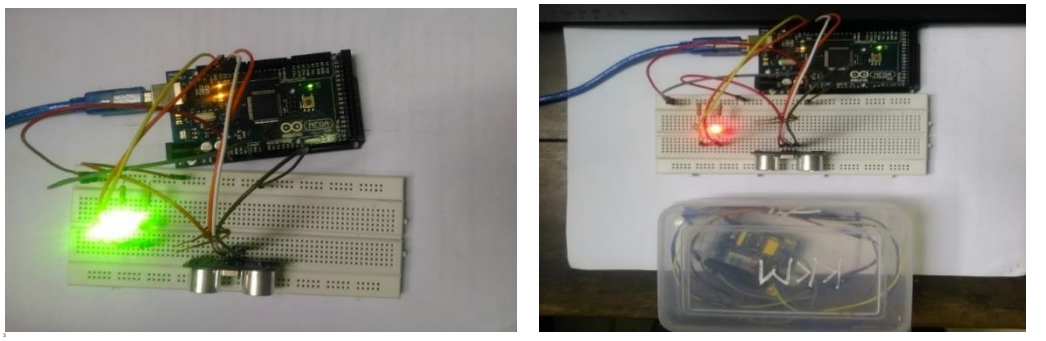
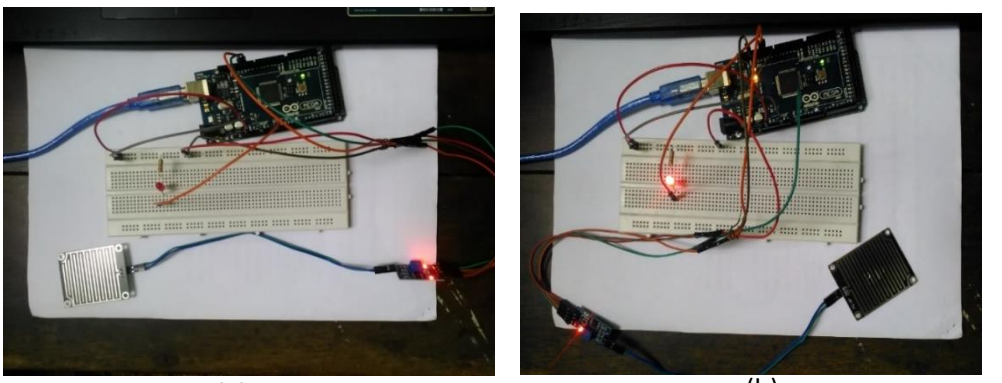


Figure 7: The components side and soldering side of the circuit board



(a) (b)

Figure 8: The photograph of the motion sensor testing condition (a) for obstacle distance greater than 6 cm (b) for obstacle distance less than 6 cm



(a) (b)

Figure 9: The photograph of the circuit operation of water sensor (a) testing for the dry sensor and (b)testing for the water present on the sensor

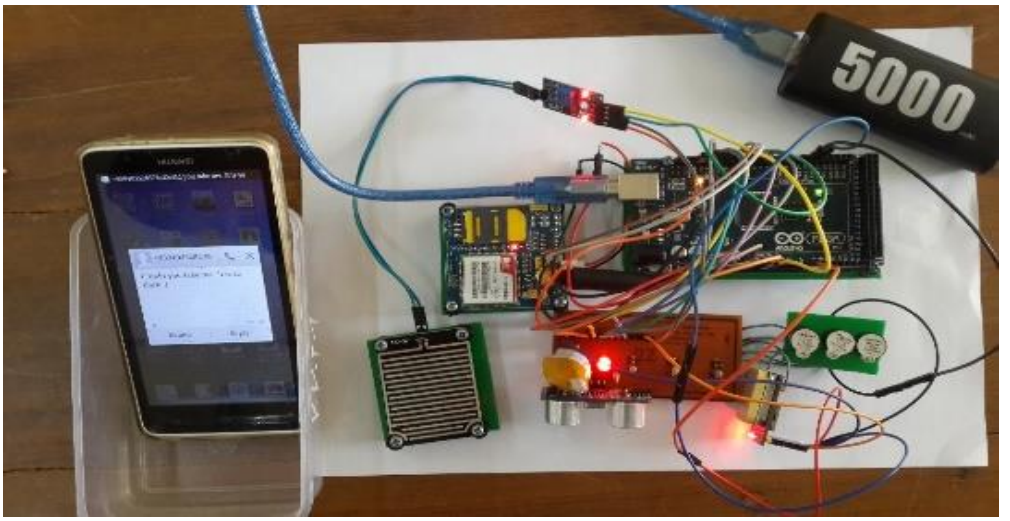


Figure 10: The photograph of the intelligent control system for walking stick

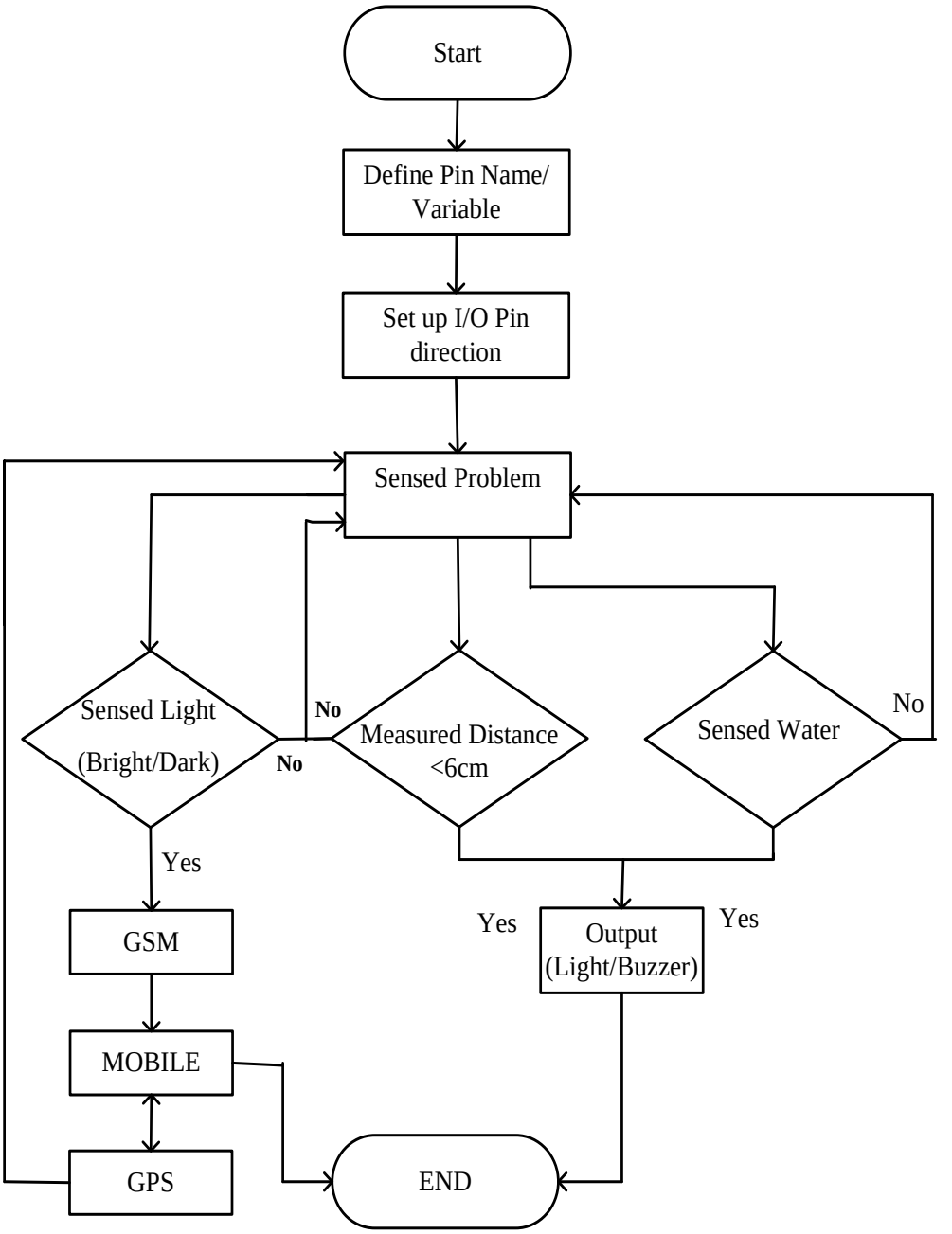


Figure 11: The flow diagram of the walking stick with intelligent control system

Discussion and Conclusion

Discussion

This research work gives the design of intelligent stick for blind person to detect any kind of obstacle by holding the stick. The stick is the most widely used travel aid for blind persons but it is not suitable for detecting potentially dangerous obstacles. The blind person can hear the sounds such as car horns but they cannot see any obstacles, which can be really dangerous. So, there is a great dependency for any type of movement or walking within area or out of the particular area, they use only their natural senses such as touch or sound for identification or walking. This walking stick for blind people has multiple sensors, with the help of which it has been possible to enhance more features to the walking stick.

Conclusion

Also, this research will aim to develop emergency trigger alert system along with design. It has an added functionality of GPS and GSM module that will enable immediate provision of help to the person in case of an emergency. The advantages of the system are the user can take easily everywhere, the system can be used both indoor and outdoor navigation. Blind person's location can be tracked whenever needed which will ensure additional safety. Detects obstacles and alerts the blind person through sound alert. The blind person holding the stick will able to move from one place to another without others help. It would become a sufficient in future for all places with demonstrated success among the public to help blind person. The objective is to provide an aid to visually impair which will assist them everywhere they go.

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