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HUMANOID ROBOT FOR ELDERLY AND CHILD GUIDANCE

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Abstract - *In recent time's robotics have gained increased importance for human assistance and guidance in many Asian countries. Among these the therapeutic robotic systems for health care monitoring using sensor framework have taken diverse forms. Extending this idea and providing advanced design which is portable, consumes less power, furnished with comprehensive judgment ability, responsiveness and memory could help in elderly guidance and child guidance. The above mentioned specifications can be achieved through a humanoid robot. The system proposed through this paper is based on the working principles of a humanoid robot (HNR). The system can operate on 3 modes, Tracking, Monitoring and General. It consists of Arduino Mega 2560 micro controller and takes input from IR sensors to control motion tracking. PIR sensors, camera (here we take input from mobile camera) and GSM modem act as input for monitoring, it uses Bluetooth module for home automation. Further the model also provides voice recognition, live streaming and remote shuttering from the emergency contact end. The system is powered up by rechargeable Lithium-ion batteries and it is portable. Firmware is programmed using Embedded C language .Therefore the main objective of the project is to produce a fully automated, reliable, responsive cognitive robot for elderly and child guidance with cost effective and low power consuming hardware.*

Key Words: **Humanoid robot, Comprehensive Judgment Ability, Responsiveness, Motion Tracking, Voice Recognition, Live streaming, Portable.**

1. INTRODUCTION

The exponential increase of the number of nuclear families in India has acted as the cause of two important problems, elderly (here denoting to the people above the age of 60) care and child (here denoting to the children between the age of 5 to 10) care. According to the statistical reports provided by The United Nations Population Fund (UNPFA), the elderly population in India has increased from 77 million in 2001 to 104 million in 2011. By 2050 it is likely to increase by three times to reach around 300 million accounting to 20 percentage of the total population of the country. But bitterly there are no sufficient human resources to provide the care required for these elders. Supporting to the above statement almost 60% families were reported to have both spouses employed and also there is a projected shortfall of 380,000 of specialized custodians by 2025. Secondly unaccompanied children also have security issues which have to be addressed. Thus this brings in a need for robots to assist the wants of the solitary elders and children.

1.1 Problems in using an HNR

Humanoids can assist with connectivity and monitoring. Never the less they can't replace humans. While human caring has been a human-to-human relationship, in the case of HNRs it is a nonhuman-to-human relationship, therefore it is essential to consider ethical concerns and human safety. For HNRs to support elders and children directly, they must have same level of comprehensive judgment ability and responsiveness as that of human custodians. If HNRs support the subjects independently, abilities which are much like those of humans will be required in them in addition to the appropriate intelligence and skilfulness to do so.

1.2 Goals

In the previous few years, robotic assistants were successfully used in many fields like hospitals, where they perform a variety of functions like custodian services, educate, or entertain. Robots have conjointly been developed for guiding blind individuals. Time is ripe to leverage this technology into the lives of elderly people and children between ages 5 to 10, where the need for personal assistance is larger than in any other age group. This project takes ideas from initial results obtained by Flo, the robot. The goal of this project is the development of personal robotic assistant that serves three primary functions:

A. ***Achieving similarity to human cognition:*** A huge fraction of the elderly population suffers from varying degrees of dementia. The inability to remember can have severe consequences. For example, subjects may forget to take medicine. This results in shifting the patient to a nursing home for human assistance. Reminding is an important (and time-consuming) activity.
B. ***Affording protection:*** Leaving elders who are physically weak and with high dementia alone at a private home can act risky. For example, if the elder accidentally falls down and if it is left unnoticed by others, dreadful consequences up to an effect of the person's death can occur. Thus loss of stability is acting as a potential risk. By decreasing such risks through methodical monitoring and protecting, the movement into nursing home or requirement of

human assistant can be delayed. Also Children below 10 require immediate attention when under threat.

C. ***Connectivity:*** Finally, most of independently living elderly people are forced to spend time alone, and are deprived of social interaction. Social engagement will considerably delay the deterioration and health-related issues. It is a known fact that robots cannot replace humans, but we try to increase the level at which robots can compensate the absence of humans, either by interacting with the person, or by acting as a communication interface between different people that is more usable.

To accommodate these needs, we are currently developing a first generation personal service robot specifically targeted at people with mild forms of dementia and children with security needs.

2. HARDWARE

The robotic system proposed through this paper is called KIMS. KIMS is supported on top of two wheeled Nomad Scout differential drive mobile base. The bespoken robotic system is built on ARDUINO Mega 2560 and it is programmed in embedded C language. There are three systems in KIMS and all the systems are activated based on the voice input. The voice recognition is achieved through voice recognition module that accepts maximum 7 voice command at a time, but allows storage of 256 voice commands. The commands and their appropriate output system simulation is shown.

Table -1: Voice input and Corresponding system simulations

Voice Input	System Simulated
Follow	Motion Tracking and Obstacle Avoidance
Monitoring	Motion Detecting and GSM modem activation
Cry Sound (ex: Aah!)	GSM Modem activation
Lights On/Off	Lighting System
Stop	Turns all the system off

Motion tracking system consists of 2 IR sensors that are capable of detecting the presence of an object in front of them by abiding the Planck's Radiation Law, Stephen – Boltzmann law and Wien's Displacement law. The inputs to the IR sensors simulate the DC motors that are present on the left and right side of the robot. These cumulatively work together to achieve motion tracking based on the table-2.

Table -2: Truth table of designed motion tracking system

Voice Recognition Input					
	0	*No Activity*			
	1	IR1(Left)	IR2(Right)	Left Motor	Right Motor
		0	0	0	0
				Stepper Motor is Activated	
		0	1	1	0
		1	0	0	1
		1	1	1	1

Both the IR Sensors are placed over the shaft of the stepper motor as shown below in figure-1

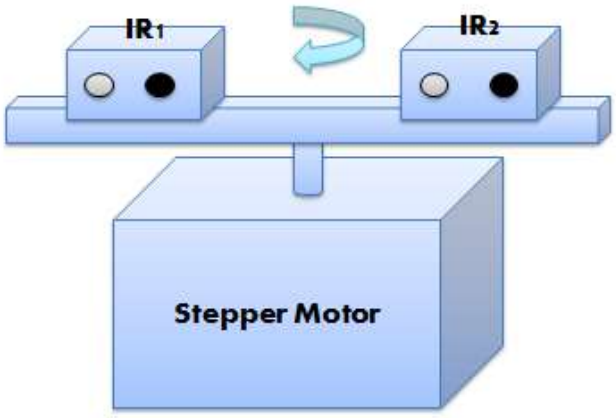

Fig -1: Illustration of amalgamated IRs and Stepper

When the inputs to both the IR Sensors remain Low, immediately the stepper motor starts turning with a resolution of 200 steps thus covering 1.8 degrees at each step given by the formula given below

$$\textbf{Angle covered during each step} = \frac{\textbf{360 degrees}}{\textbf{No. of Steps}}$$

At any point if any of the IR input becomes High the stepper motor switches off and normal operation returns.

Monitoring system consists of Passive Infrared sensor and a GSM modem. It is activated in two ways. One way of powering up the monitoring system is on voice inputs "*Aah*" or any other cry sound. Immediately the GSM modem sends a short message stating "*Cry sound heard*" to the emergency contact number. Other way of activating the monitoring system is the voice input "*Monitor*". In the second case the GSM modem waits for input from PIR sensor. If input remains low for the programmed calibration time i.e. the PIR detects no motion then it immediately stimulates the GSM modem which sends a message to the emergency contact stating "*No motion detected*". In both cases GSM modem waits for return message "*OK*" from the contact, if no return message is received it sends the same message again and again for every 20 seconds.

Home Automation system consists of the bot as the central hub that connects various hardware components through wired or wireless connections (here Bluetooth), whose activities are controlled through voice inputs. The Bluetooth based Home automation through voice recognition provides efficient and low cost and secured system. The basic blocks of our bots home automation system is shown in figure-2.

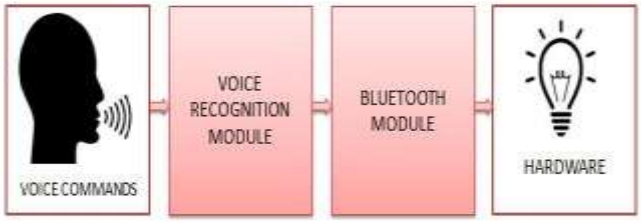

Fig -2: Bluetooth based Home automation controlled over voice commands.

3. SOFTWARE

At the present time, KIMS is made of two major software subsystems, each of which is designed with a specific goal in mind for assisting the elderly and children.

Tele-Presence Interface: Our main objective is not to replace the human assistant but to aid the communication between users and other people. Instead of supplanting someone KIMS facilitates the interaction between the person and user. By providing a communication interface between the surrounding environment and the person, which is achieved by sending appropriate messages to the emergency contact at appropriate instances and situations the robot increases the user's contact with the outside world at relatively little effort. The tele-presence interface embodies a camera (here we use a mobile camera) that transmits the video signal to a remote station or gadget that is built on android OS. The video signals are transmitted to the receiver gadget over the wireless Bluetooth connection. Furthermore, the tele-presence also extends control of the robotic camera by another emergency remote user. Using a mobile app developed through android studio for controlling the camera position and angle, respective responsible person, friend or relative can alter the camera angle to achieve surveillance around the user's room. The screenshots of the application developed for camera live streaming which can also support remote shuttering is shown in figure-3. The screenshot of application developed for altering the angle of servo motor that supports the mobile camera is shown in figure-4.

Fig -3: Application for Live Streaming and remote shuttering.

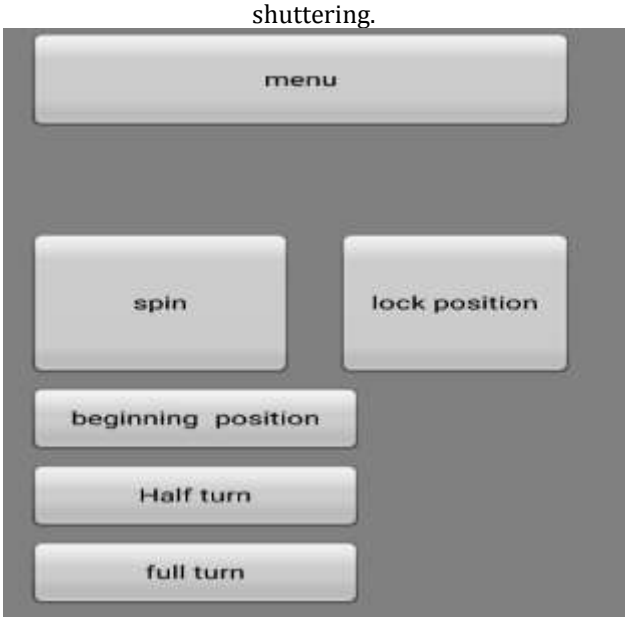

Fig -4: Application for altering servo motor position

Speech Recognition Interface: One amongst the important objective of designing process is to generate a natural interaction between the users and the robot. Most commonly the elderly people find difficulty in interacting using unknown or unfamiliar means of communication example such as keyboard and computer screens. Thus it is ultimately necessary that the robot establishes communication through means that are familiar to elderly people and children. Thus achieving spoken interaction with the robot is absolutely essential. KIMS consists of a real-time speech interface. The speech recognition system is based on V3 voice recognition module. It is a compact and easy-control speech recognition board. This product is a speaker-

dependent voice recognition module. It supports up to a total of 80 voice commands. Maximum of 7 voice commands could be fed as input at the same time. Any acoustic input could be trained as command. Users need to train the module first before letting it recognizing any voice command This board can be controlled in 2 ways they are Serial Port (full function), General Input Pins (part of function). Thus at present KIMS can identify 7 voice commands and stimulate the appropriate system. This enables KIMS to understand commands such as *"Hello", "Follow", "Monitor", "Cry sound", "Lights ON", "Lights OFF", "Stop".*

4. DISSCUSSION

The block diagram of proposed system is shown in figure-5. Through this paper we reported the initial design and outputs of mobile robot aimed at the elderly and child population. Understanding the necessity and significance of providing supervision for elderly and child population, we are now developing a humanoid robot that will provide a variety of services to solitary living elders and children. Additionally we would like to make students aware of the extremely high end features of AT-Mega microcontrollers that can help in providing high end facilities at low expenditure. We hope that through this research we at least managed to achieve a minute fraction of the enormous challenge of servicing the solitary elders and children.

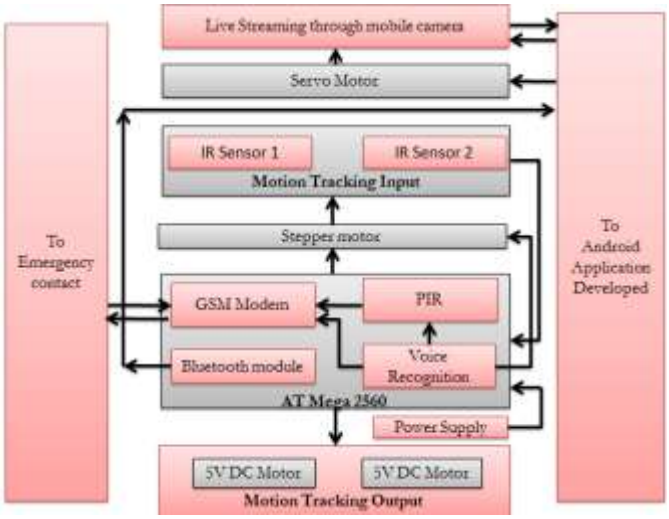

Fig -5: Block Diagram of Proposed model.

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