# EMBEDDED CONTROL SYSTEM FOR SMART WALKING ASSISTANCE

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**ABSTRACT:**
We present a novel system to achieve coordinated task-based control on a dual-arm industrial robot for the general tasks of visual serving and bimanual hybrid motion/force control. The industrial robot, consisting of a rotating torso and two seven degree-of-freedom arms, performs autonomous vision- based target alignment of both arms with the aid of fiducially markers, two-handed grasping and force control, and robust object manipulation in a tele-robotic framework. Industrial robots traditionally are preprogrammed with teach pendants to perform simple repetitive tasks without any sensor feedback. This work was motivated by demonstrating that industrial robots can also perform advanced, sensor based tasks such as visual servoing, force-feedback control, and tele-operation. Industrial robots are typically limited by the long delay between command and action, but with careful tuning, we show that these sensor-based methods are still feasible even with off-the-shelf sensors.

***Keywords****: Raspberry Pi, MEMS, DC Motor.*

## INTRODUCTION

Elderly care is one of the many applications supported by real-time activity recognition systems. Traditional approaches use cameras, body sensor networks, or radio patterns from various sources for activity recognition. However, these approaches are limited due to ease-of-use, coverage, or privacy preserving issues. More number of people aged in next generation due to yearly increasing aged people ratio compared to other people. Loosing complete or part of mobility, affects not only the ability to walk but also the affect on daily life that is a major determinant in life quality and causes dependence of others in daily life. In an aging society it is extremely important to develop devices, which can support and assist the elderly people by moving robot in his intentional direction. Elderly tend to have cognitive impairments and experience more serious falls but there is strong evidence that daily exercise may result on fall prevention and postural stability. So, it becomes more and more relevant to find ways and tools to compensate to improve or to restore and to enhance this mobility. Intelligent robot is to perform optimized actions to help the user's walking or facilitate their recovery. The sanctions include guiding, fall pre-venting, and rehabilitation training, and so on. To provide these optimized actions, one of the most important tasks that should be accomplished by the robot is to correctly estimate the user's walking intention by his leg moment. From the viewpoint of the robot control system, the user's walking intention of the leg provides the robot motion controller. Therefore, in this Project focus on the design of robot motion control strategy, in which the user's walking intention should be explicitly find by his leg moment this control strategy plays an important role in the design.

## LITERATURE SURVEY

According to, technology can help in reducing many barriers that people with disabilities face. These kinds of technologies are referred to as assistive technology (AT). There are many types of disabilities, including physical disabilities, hearing-impaired, and visually-impaired. AT has been utilized in assisting them. However, developing an AT is expensive, making their selling price high.

According to Mazo and Rodriguez the blind Cane is one of the assisting tools for the visually-impaired and it is really important. According to Herman , one of the main problems of the visually-impaired, is that most of these people have lost their physical integrity. Also, they do not have confidence in themselves. This statement has been proven by Bouvrie, in which an experiment name ―Project Prakash has been carried out. It was intended at testing the visually-impaired to utilize their brain to identify set of objects. According to Chang and Song, this can also be applied to different situation. When the visually-impaired walk into a new environment, they will find it difficult to memorize the locations of the object or obstacles. These examples demonstrate the difficulties of visually-impaired people.

The Guide Cane is designed to help the visually-impaired users navigate safely and quickly among obstacles and other hazards. Guide Cane is used like the widely used white cane, where the user holds the Guide Cane in front of the user while walking. The Guide Cane is considerably heavier than the white cane, because it uses a servo motor. The wheels are equipped with encoders to determine the relative motion. The servo motor, controlled by the built-in computer, can steer the wheels left and right relative to the cane. To detect obstacles, the Guide Cane is equipped with ten ultrasonic sensors. A mini joystick located at the handle allows the user to specify a desired direction of motion. Guide Cane is far heavier than the ordinary white cane and also it is hard to keep because it cannot be folded.

Smart Cane is one invention which was originally the creation of a common blind cane but it is equipped with a sensor system. This invention resembles Guide Cane where this invention has a number of ultrasonic sensors and servo motors. This invention is designed with the aim at helping the blind in navigating. Ultrasonic sensors need to detect and avoid obstacles or objects located in front of the user. Meanwhile the fuzzy controller is required to determine the instructions that will be executed for example to turn right, left or stop. Like Guide Cane, this invention also has a control button on the handle, and the button has four different directions. This invention has the same weaknesses as the Guide Cane where there will be a problem to save space or to place the smart cane. Besides that, cost is also a weakness in this project as it uses ultrasonic sensors and a number of servo motors. If the cost is too high, users are not able to afford for it because the average income of the visually-impaired people is relatively small.

Smart Cane has been designed by students from Central Michigan University where this invention uses Radio Frequency Identification (RFID). RFID is used to detect objects or obstacles in front of the user and detects the RFID tag that has been placed in several areas to navigate the users. This invention is just like a normal stick but is equipped with a bag, worn by the user. The bag supplies electricity power to the invention and informs the user through speakers inside the bag. For users who do not have the ability to hear, there are special gloves that will vibrate at every finger, in which different vibrations in each finger have different meanings. However, this invention has several weaknesses and is only suitable for small areas. This is because it only detects the area with RFID tag otherwise this invention only works as a regular blind cane. In addition, this invention requires a high cost if it is used in the external environment because the larger area that need to be tagged, the higher cost is needed.

Mechatronics Blind Stick is a guiding system, designed to facilitate the daily work among the visually-impaired people. This invention has many similarities with the Smart Blind Cane. In which this invention uses ultrasonic sensors and sound vibrations. However, this invention also has several weaknesses; it cannot be folded and difficult to keep. In addition, this invention is not equipped with sensors to detect the water areas.

**Methodology**

A sensor system is proposed in this paper which is based on micro electro-mechanical sensor (MEMS). The micro-mechanical device which is embedded with electronic/electrical system and fabricated through IC manufacturing and micro-machining process. In this micro machining process the material is shaped by etching away the micro layers and so called MEMS. We use MEMS because of its compact size and volume, it is cheaper and has very low power consumption, It is highly resistant to heat, shock, vibration with improved thermal expansion tolerance. The use of MEMS can be found everywhere in consumer appliances, automobiles, computer peripherals, military, biotechnology and so on.

In this project we use a 3- Axis orientation/Motion detection sensor(A low profile capacitive MEMS sensor featuring upto 6-bit data samples per second or at the rate of user configuration), with the weight of the sensor around 1.5 grams. To sum up, this paper gives the following contributions: -

- It Measures the moments of the person given by using MEMS Sensor.
- Convert the MEMS analog Information into Digital by using MCP3208.
- Collect the data from MCP3208 and analyze it.
- Control the Robot directions and ARM movements based on inputs of MCP3208 and Slide switch.

## HARDWARE SYSTEM

In system construction, it mainly consist of two part namely as software part and hardware part.

In this Hardware part having Robot sections it having the Raspberry Pi, MEMS Sensor, DC Motor, Slide Switch.

## ROBOT SECTION:

In this section, we introduce our setup and conduct the preliminary experimental results to shoe the robot movements. It contains the ADXL MEMS sensor for collecting Human movements. It is analog based accelometer sensor. The output will be given to the MCP3208 for converting analog to digital. The converted output will be given to the Raspberry pi by using SPI protocol it is a 4 wire protocol.

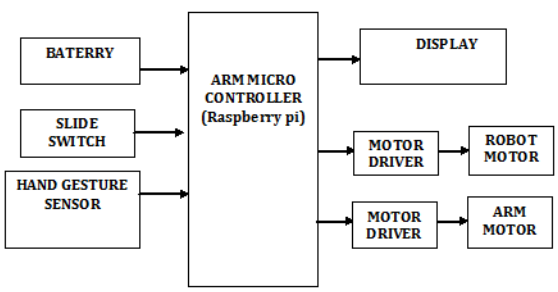


Fig.1. Block diagram

The information Received from the MCP3208 will be analyzed by in the Pi based on the coding. In this circuit having Slide switch for changing the mode of operation. In this controlling circuit operates in two modes one is Robot mode in this Based on Human Gesture Movements it will control the Direction of the Robot. Second mode is ARM Mode in this mode based on Human Gestures it will control the Robotic Arm Directions.

## Hardware Requirements

### MEMS:

Micro-Electro-Mechanical Systems (MEMS) is the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. While the electronics are fabricated using integrated circuit (IC) process sequences (e.g., CMOS, Bipolar, or BICMOS processes), the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices. MEMS promises to revolutionize nearly every product category by bringing together silicon-based microelectronics with micromachining technology, making possible the realization of complete systems-on-a-chip. MEMS is an enabling technology allowing the development of smart products, augmenting the computational ability of microelectronics with the perception and control capabilities of micro sensors and micro actuators and expanding the space of possible designs and applications.

Microelectronic integrated circuits can be thought of as the "brains" of a system and MEMS augments this decision-making capability with "eyes" and "arms", to allow micro systems to sense and control the environment. Sensors gather information from the environment through measuring mechanical, thermal, biological, chemical, optical, and magnetic phenomena. The electronics then process the information derived from the sensors and through some decision making capability direct the actuators to respond by moving, positioning, regulating, pumping, and filtering, thereby controlling the environment for some desired outcome or purpose. Because MEMS devices are manufactured using batch fabrication techniques similar to those used for integrated circuits, unprecedented levels of functionality, reliability, and sophistication can be placed on a small silicon chip at a relatively low cost.

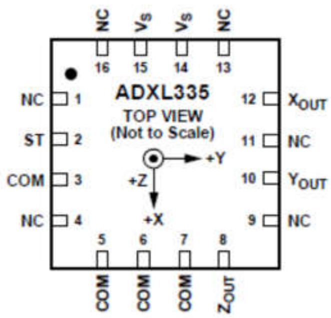


Fig.2. MEMS IC

**MCP3208**

The Raspberry Pi computer does not have a way to read analog inputs. It's a digital-only computer. So we need analog to digital converter circuit in our application so we are Prefers MCP3208. It is a successive approximation 12-bit Analog to-Digital (A/D) Converters with on-board sample and hold circuitry. It converts analog values into digital and that output will be given in communication format. Communication with the device is accomplished using a 4-wire SPI compatible interface.


Fig.3. MCP3208

## RESULTS

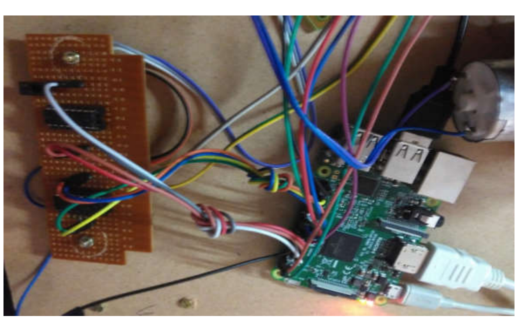

Fig.3. Hardware Model of Application

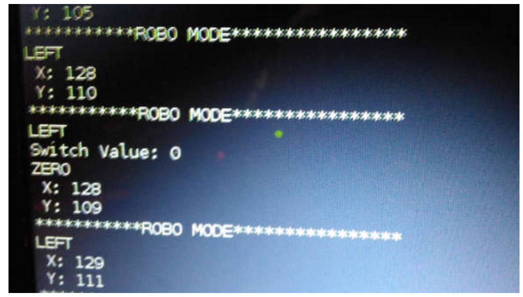


Fig.4 (a).

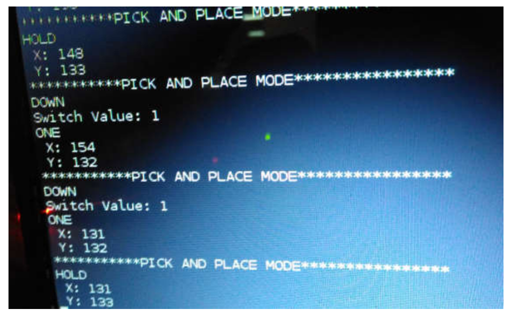


Fig.4 (b).

Fig.4 (a), 4(b) Ui Window output.

**CONLCUSION**

The prototype of walking stick system with the implementation of the presented control system has been proven in experimental study for being very intuitive and easy to adopt by the users. It is necessary to find an easy to perform and accurate method for walking assistance device since it will be used by physically weak people and patients suffering from neurological damage.

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