**Literature Survey**

By Reshma & Hitesh

1. **Article Title:** Soft Robotics in minimally invasive surgery.

**Problem Finding:** The problem defines it as difficult to compare candidate devices and identify knowledge gaps, engineering challenges, and improvements. There was low diversity in the device designs and a wide-ranging level of detail regarding their capabilities**.** There is another problem that measuring a device using only a limited quantity when it is dependent upon each other.

**Solution:** To resolve the problem they proposed a template for designers graphically define relationships such as stiffness, speed, and deflective versus torque and 3D workspace and there are many more. understand current technologies, we carried out a keyword search using the Web of Science and Scopus databases, applied inclusion and exclusion criteria, and compared several characteristics of the soft robotic devices for MIS in the resulting articles.

#### Tools/Technologies Used: Sensors (proprioceptive sensors, exteroceptive sensors, diagnostic sensors)

#### b) Article Title: Medical robotics for ultrasound imaging: current systems and future trends.

#### Problem Findings: Teleoperating systems show the highest level of technical maturity. Collaborative assisting and autonomous systems are still in the research phase, with a focus on ultrasound image processing and force adaptation strategies. However, missing key factors are clinical studies and appropriate safety strategies.

#### Solution: In the past five years they subdivided into teleoperation, collaborative assistance, or autonomous systems based on LORA, and these schemas are mostly used to solve problems. Teleoperated is used to perform remote exams at varying distances. The collaborative assisting system focuses on supporting sonographers during exams. Finally, future trends for robotic ultrasound systems are focused on artificial intelligence and virtual reality.

#### c)Article Title: Framework for IoT robotics applied to smart healthcare and emotional well-being.

#### Problem Finding: Failed in attention towards the right design of applications that are usable by elderly people. And this research paper solves how can the internet of robotic technology helps to design emotional-based robotic applications.

#### Solution: They solved the problem by using three social robots called buddy, ASTRO and RoboHon these assist elderly people to stay independent at home and improve their socialization in the context of the ACCRA project. These three robots understand and convey emotions in real-time using the Internet of Things and Artificial Intelligence technologies. Mainly the robots embed three kinds of emotionally based applications. (mobility, daily life, and conversational)

#### Tools/Technologies Used: Agile, and DevOps these methodologies are used.

#### d) Article Title: Soft Exosuit Assisting Hip Abduction for Knee Adduction Moment Reduction During Walking.

#### Problem Finding: There is a problem with how to evaluate the ability to reduce KAM(knee adduction moment). It means excessive loading over time can lead to knee osteoarthritis (OA), the progression of which is correlated with external knee adduction moment (KAM).

#### Solution: During resolving the problem they explored five force profiles on healthy participants walking on an instrumental treadmill. They designed and validated the initial performance of a hip abduction to reduce KAM. They used a trajectory generator which allowed them to iterate through a variety of one-peak and two-peak assistance force profiles. First and foremost, our experiment did not reveal a correlation between force profile shape and KAM reduction.

#### Tools/Technologies Used: Components used are the sensor system and the Actuation system. Testing is done through an experimental protocol, Data collection, and analysis.

#### e) Article Title: EMG Controlled Soft Robotic Glove for Assisting activity of daily living.

#### Problem Finding: They are finding to create a soft glove that can assist individuals with functional grasp pathologies in performing activities of daily living.

#### Solution: The glove technology utilizes a combination of elastomeric and inextensible materials to create soft actuators that conform to the user’s hand and can generate sufficient hand closing force to assist with activities of daily living. Gloves functionality works on grasp, hold and release. They demonstrated that it is possible to use an open-loop sEMG signal as a way to detect the intent of the wearer. Finally, it is shown to be able to successfully monitor muscle contractions in the flexors and extensors.

#### f) Article Title: An implantable extracardiac soft robotic device for the Failing Heart: Mechanical coupling and synchronization.

#### Problem Finding: This article describes the optimization of an implantable soft robotic system for heart failure whereby soft actuators wrapped around the ventricles are programmed to contract and relax in synchrony with the beating heart.

**Solution:** The in vivo results highlight some important trends. Mechanical coupling between the actuators and native heart showed a consistently significant augmentation in cardiac output. The importance of accurate time synchronization between external cardiac compression devices and the native heart was also evident in these studies.

**g) Article Title:** Approaches to real-time ventricular wall strain measurement for the control of soft robotic ventricular assist device.

**Problem Finding:** Current prototypes of SR VADs have relied upon blood pressure and flow measurements to assess device function, which are the secondary results of the VAD, as opposed to measuring wall deformation. Further, control inputs determining the level of deformation to apply to the heart have relied on preset parameters after optimization. Therefore, there exists a need for a continuous real-time assessment of the level of strain being caused by the SR VAD both to assess the local effects of the device on the heart muscle wall and also as a feedback input for the real-time optimization of the device control.

**Solution:** Following further experimentation, the main concept may become a promising solution for detecting the stain of the curved heart wall. For the HE sensor, altering the method of adherence to accommodate for the sensor’s reliance on component alignment must be implemented to integrate it as an SR VAD strain sensor.

**h) Article Title:** Biologically inspired soft robot for thumb rehabilitation.

**Problem Finding:** Several systems have been designed to assist in the patient articulation of an impaired hand using rigid robotic components. While these products have been successful in articulating the pure bending motions of the four fingers, the limited capabilities of rigid technologies fail to reproduce the complicated motion path of the thumb during opposition grasp. This is the most important articulation for normal hand function and specifically for picking up everyday objects. To date, robotic systems for thumb rehabilitation have not been widely investigated apart from some recent work that used a multi-joint rigid robot.

**Solution**: Abiologically inspired soft robotic thumb rehabilitation system was shown to have the capability to reproduce the motion path of a thumb during opposition grasp. Through a linear combination of basic motion strain-wrapped actuators, a soft robotic design could be fabricated to fit a complex motion path. Integrating this with a lightweight hand fixation and a compact control system produced a promising prototype for a wearable, at-home, task-orientated thumb rehabilitation device.

**i)Article Title:** Soft Wearable motion sensing suit for lower limb biomechanics measurements.

**Problem Finding:** Motion sensing has played an important role in the study of human biomechanics as well as in the entertainment industry. Although existing technologies, such as optical or inertial-based motion capture systems, have relatively high accuracy in detecting body motions, they still have inherent limitations with regard to mobility and wearability.

**Solution:** In this paper, we present a soft motion sensing suit for measuring lower extremity joint motion. The sensing suit prototype includes a pair of elastic tights and three hyperelastic strain sensors. The strain sensors are made of silicone elastomer with embedded microchannels filled with a conductive liquid. To form a sensing suit, these sensors are attached to the hip, knee, and ankle areas to measure the joint angles in the sagittal plane.

**j) Article Title:** Soft Robotics in medical applications.

**Problem Finding:** The research challenges in sensor integration, fabrication materials, and nonlinear control in continuum soft robots, portable and robust actuation power sources, clinical adaptability, and clinical regulatory affairs. Integrating sensors with a soft robot could provide more accurate feedback for robot control. However, it is difficult to integrate conventional sensors with soft robots due to the flexibility/elongation difference between the materials that comprise the soft robot and conventional rigid sensors.

**Solution:** Park et al presented a soft strain sensor that calibrates electrical resistance increases of conductive liquids in the sensor due to the variation in cross-sectional area and channel length caused by the strain and pressure on the soft rubber. Stretchable electronic skin is another type of soft sensor proposed in 2013, which could be used to detect haptic information through human touch. Bao et al designed tiny soft pillars which contain electrically conductive materials to sense pressure, which could be used in prosthetics.

Links for more Research papers

: <https://link.springer.com/content/pdf/10.1007/s12369-021-00821-6.pdf>

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