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Improved Efficiency in Agriculture with Smartphone Operated Robot

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ABSTRACT: Indian economy being an agrarian economy the significance of the agriculture system is more and so there is a need to find new ways to improve efficiency in cultivating crop production. With the advancement in technology various agriculture equipments can be developed based on small smart machines making tasks simpler for humans and in an appropriate manner. This paper introduces an approach in which, with the help of available information technologies in the form of an intelligent machine like a smart phone operated robot, the load of the human work can be reduced and energy inputs can be targeted in more effective ways than in the past.

KEYWORDS: Android, Basic4android, Bluetooth

I. INTRODUCTION

With the advancement in technology, more care is being taken for the devices to be smart as well as human friendly. Robots are basically machines that are being used as replacements for humans in the processes involving a lot of physical strain and monotonous and continuous decision making but with great degree of accuracy. A robot requires a high performance computer or microprocessor as a central control unit, but care needs to be taken in the choice of the chip so that the machine doesn't become bulky along with achieving a good efficiency in computation. The emergence of smart phone and its popularity among humans have paved way for the idea proposed in this paper. Smart phones have become an indispensable device in a human's life. With the advancement in technology, a smart phone capable of performing greater tasks with better efficiency and feasibility is available in the market at reasonable rates to the users. With the various advantages of smart phone, this technology is supposed to stay and rule the market for coming years. Using the benefit of this technology which is accessible to as many users in the country, a scheme is proposed in this paper in designing a human assisted robot that uses the smart phone to take in commands. Smart phone as a device provides good computation in the tasks and is also convenient to handle operations like camera monitoring, Bluetooth or wireless internet access by WIFI. With the use of various powerful high end applications, the robot can be made smarter and more intelligent. With the popularity of the development of the smart phone in the current market scenario, the developed product can also be commercialized.

II. RELATED WORK

[1] describes the mobile robot and a Smartphone which operates on Symbian operating system and uses Bluetooth technology for communication and the various navigation algorithms for demonstration of application.[2] this paper describes the image compression using android application which is obtained by controlling the robot through 802.11x wireless LAN communication and utilizing TCP/IP communication socket programming.[3]The robot is developed using audio as the control interface using Smartphone. A novel closed loop control system based on audio channels is described in this paper. [4] A remote toy car is controlled by an android mobile using Bluetooth along with drivers and motors. The paper also describes the designing of android application and also the demonstration of the system.[5] This paper introduces the application of Smartphone controlled robot in industrial domain. The proposed system is used in welding, pick and place of objects etc.[6] Different types of crop production techniques are presented in this paper, using the idea of robot controlling through android based mobile phone.

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III. SYSTEM STRUCTURE AND EMBEDDED ANDROID SYSTEM

In this work a new robot system is introduced, which is controlled by a smart phone. The Bluetooth specification inbuilt in an Android smart phone is used to control the robot wirelessly. In this paper, the Android smart phone is used as a remote control for operating the robot which finds application in agriculture. The following figure shows the developed robot system structure.

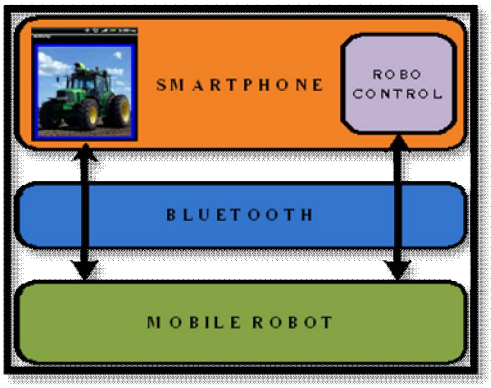

Fig.1. System structure

A. Android platform & Bluetooth Communication

Now-a-days, the most popular operating system presented in personal computers, handheld devices and other terminal equipments is Android which is developed by Google and has a plan to extend the control abilities of a android mobile device. The Android system can be divided into four levels in all, where Linux forms the core bottom level, which is followed by the Library and Dalvik VM, and the top level application programs. Each level has a component related to the proper operation of a Bluetooth device. In an embedded OS, Linux, Windows-CE, and Android are well known OS. Android is a JAVA language based OS, enabling C/C++ language compatibility by JNI (Java Native Interface). BlueZ is Android Bluetooth protocol stack which supports GAP, SDP and RFCOMM standard and is authorized by SIG (Bluetooth Special Interesting Group). The android Bluetooth protocol can be viewed in FIG 1.3 As a popular mobile operating system, the Android platform supports the Bluetooth communication stack that allows devices to transfer and receive data and instructions with other paired Bluetooth devices.

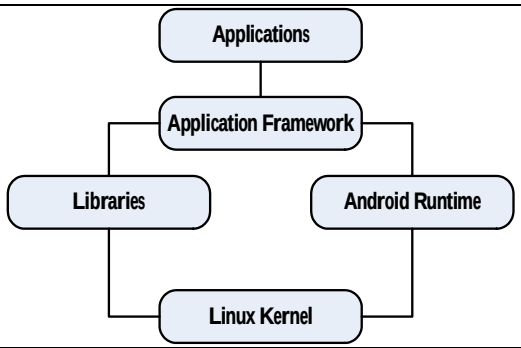

Fig. 2. Android System Architecture

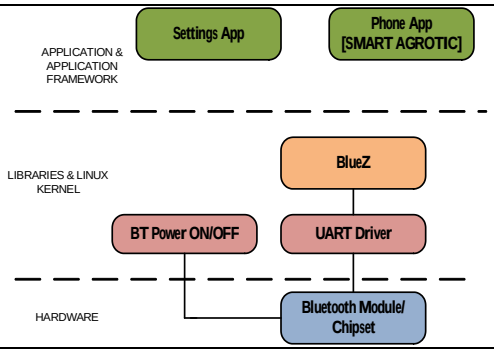

Fig.3. The Android Bluetooth Protocol

IV. WORKING AND SYSTEM DESCRIPTION

The microcontroller is the main controlling device of the entire system to which the Bluetooth module and DC motors are interfaced. The Bluetooth module of the Android smart phone provides the data which is fed as input to the

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controller. According to the received data the controller operates the DC motors of the Robot. The robot can be made to move in all the four directions i.e. right, left, forward, ,backward using the Android phone. In order to achieve the task, the controller is loaded with a program which is written using Embedded basic language. The figure below gives the basic block diagram of the entire system.

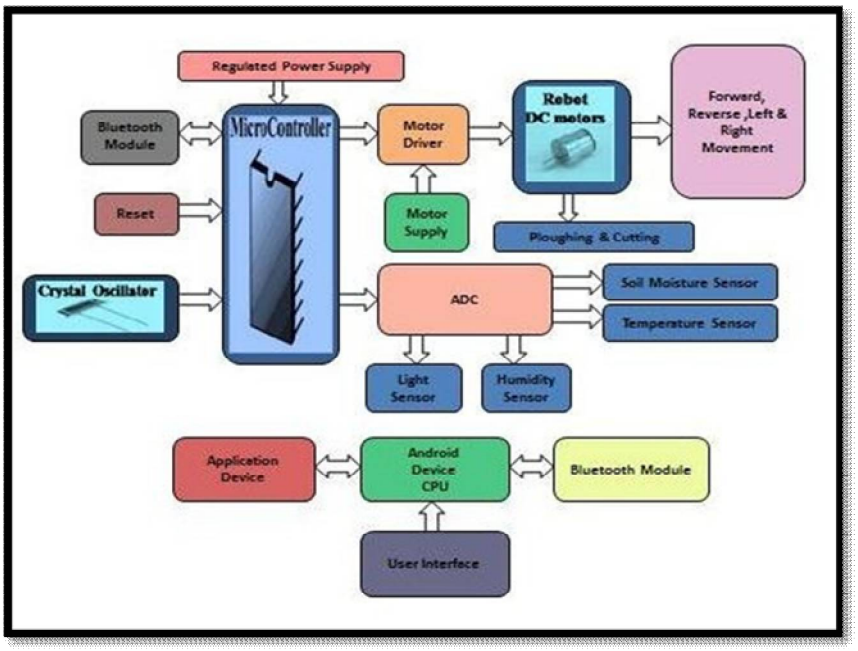

Fig.4. Block Diagram Of System

Fig.5. Prototype of Smartphone Controlled Robot

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TABLE.I
PROTOTYPE COMPONENT LIST

Serial No.	Components	Value
1.	Microcontroller	Atmega AT89S51
2.	Liquid Crystal display (LCD)	016M002B,16*2 character LCD
3.	Positive Power Regulator	LM78L05
4.	Analog to Digital Converter (ADC)	ADC 0808
5.	Bluetooth Module	CSR BC417
6.	DC Gear Motor	Copal16 mm Gear motor HG16 Series (4 nos.)
7.	Relay	NT73(JQC-3FC)

V. SOFTWARE DEVELOPMENT

Software development is categorized in two parts as - Microcontroller Software Development and Android Software Development.

A. *Microcontroller Software Development*

The microcontroller is responsible for proper process flow in the system. The flowchart below shows the step by step process flow in the microcontroller. Variables T(temperature), H(humidity), Light(L), M(moisture) needs to be defined. The port 2 being bi directional needs to be set as only input port. The data coming from the sensors are given to ADC, which calculates the binary's decimal equivalent. Once the data is converted properly, it is given to LCD. A variable A is defined, which controls the motor action. The motors being connected to port 3, the values of port 3 are set according to the value of A to perform the desired motor action.

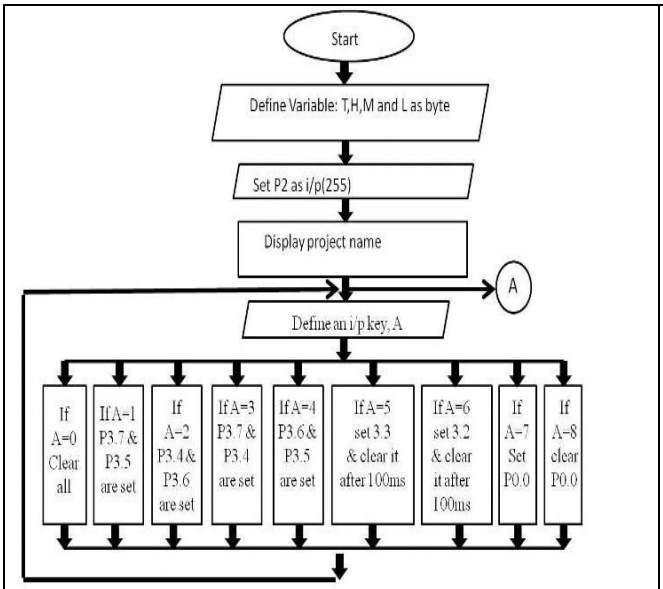

Fig.5.1.Process Flow of Microcontroller

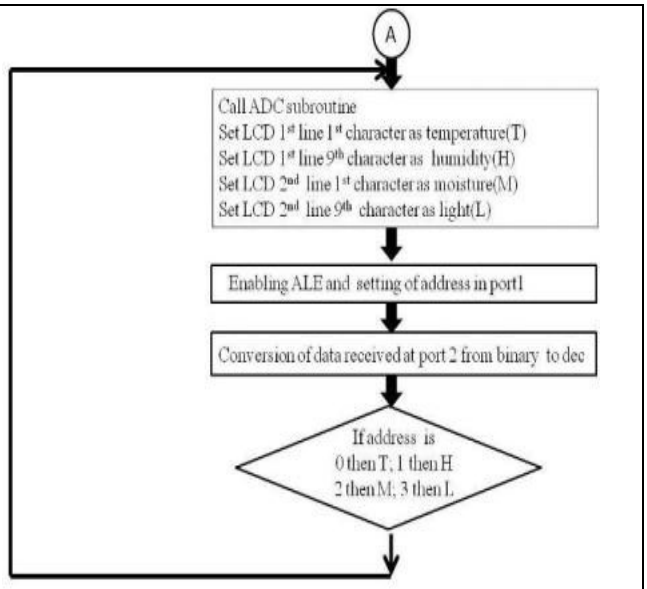

Fig.5.2.ADC Subroutine

B. *Android Software Development*

The project involves developing an application which has a user friendly graphic user interface (GUI). The application was developed using Basic4 android application development tool. It is an event driven programming approach and the application generated in this project uses the following subroutines:

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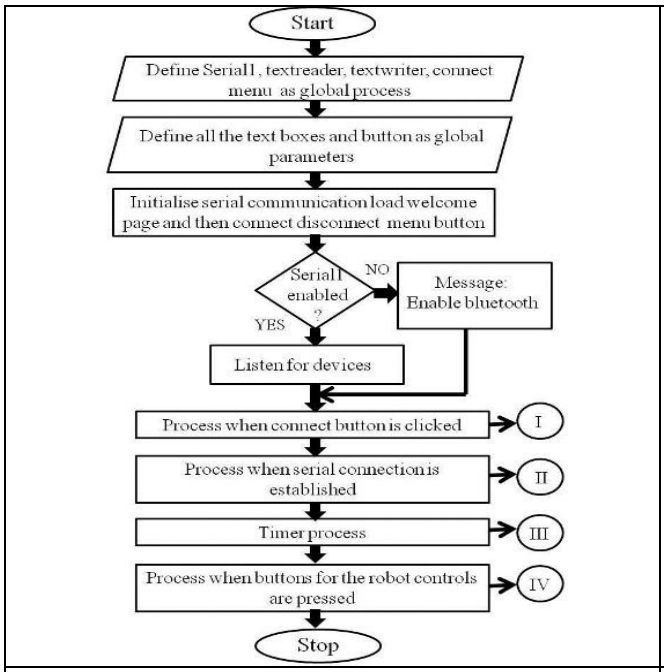

Fig.6.1. Initialization of the designer

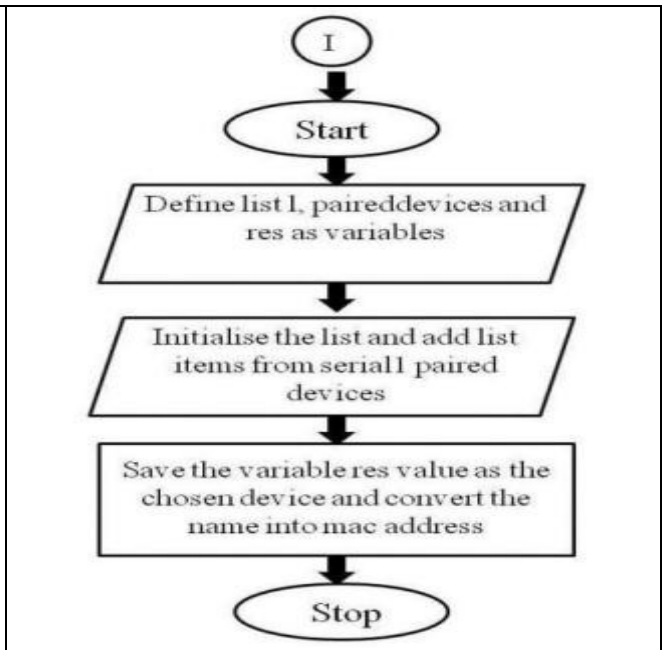

Fig.6.2.Process when connect button is clicked

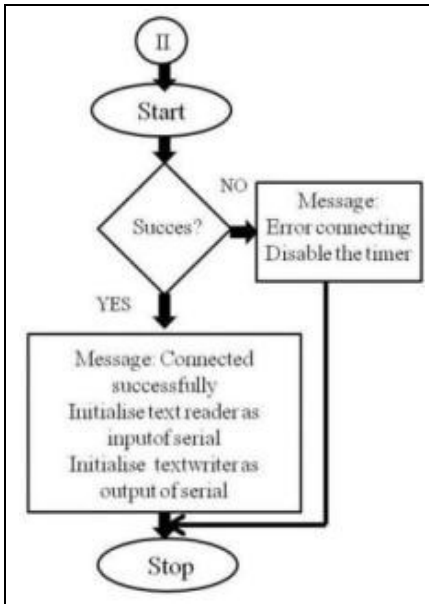

Fig.6.3.Process when serial connection is established

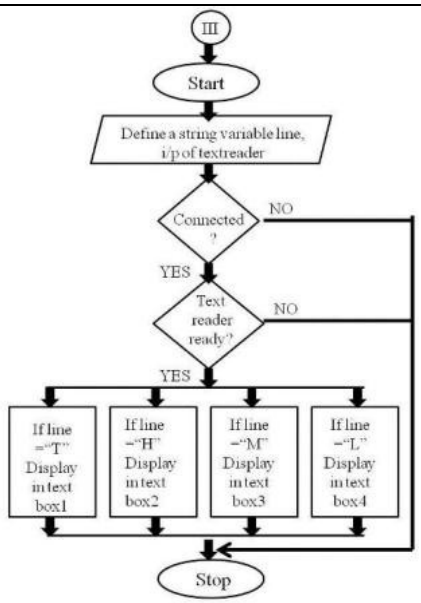

Fig.6.4.Timer process

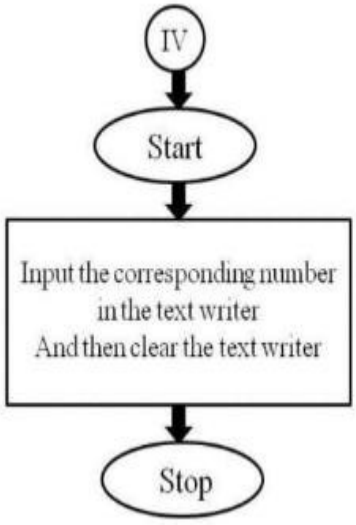

Fig.6.5.Process when buttons for the robot controls are pressed

VI. GUI DESIGN AND STEPS FOR CONNECTING TO ANDROID APPLICATION

STEP 1. Install Smart Agrotic Application in Smartphone and it will be shown in Application list
STEP 2. Waiting for IDE Debugger to connect to application
STEP 3. After connection it will show the first page i.e. Smart Agrotic
STEP 4. After first page, it will show the message box “Please Enable Bluetooth”

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STEP 5. Pressing Menu it will show Connect and Disconnect option for Bluetooth
STEP 6. Clicking on connect it will show all paired devices for connection and disconnect will close it.
STEP 7. After Connecting To Bluetooth Module, It Will Proceed And Show Next Page
STEP 8. Next page is status and control through which we can control robot and get status.

Fig.7.1.Smart Agrotic in Application List

Fig.7.2.Connecting Page

Fig.7.3.First Page of Application

Fig.7.4.Bluetooth Enable Message

Fig.7.5.Connect and Disconnect option for Bluetooth

Fig.7.6.List of Paired Devices

Fig.7.7.Project Info

Fig.7.8.Status and Control page

VII. SIMULATION & TESTING RESULTS

Initially data is received on smart phone through Bluetooth from robot via its sensors. Then the controlling commands are given to robot via the application.

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Commands given to robot through Smart Agrotic application

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Fig.8.1. Data received from sensors of robot via Bluetooth, the robot is controlled via Smart Agrotic Application.

VIII. APPLICATION IN AGRICULTURE

The idea of agricultural environments being serviced by smart machines is not a new one. The main idea is to make these machines intelligent enough to work in an unmodified or semi natural environment. By making them intelligent, the task is to make them perform in a sensible behaviour when put under some recognized contexts in which they are trained or programmed to. They should have enough intelligence embedded within them that they perform their task unattended for longer periods of time in a sensible manner. These are the following applications included in the project:

a) Temperature sensing
b) Humidity sensing
c) Soil Moisture sensing
d) Light sensing
e) Ploughing & Cutting.

IX. CONCLUSION

The idea of controlling the robot through Smartphone implemented through this paper has proven a way for meaningful two-way communication between the Android, controller and the robot, which would allow a non-expert to interact with and adjust the functionality of a process which uses robotic systems. The application developed through this project helps in obtaining data regarding soil moisture, temperature and humidity. The developed system can be extended to allow for real time control of the robotic arm with the built-in accelerometer and gyroscope of the Smartphone. Even though the paper deals with the agricultural application in specific but the idea behind this paper can prove to be useful in industrial environment.

X. FUTURE SCOPE

The developed system can be extended to allow for real time control of the robotic arm with the built-in accelerometer and gyroscope of the Smartphone. Even though the project deals with the agricultural application in specific but the idea behind this project can prove to be useful in industrial environment. And besides stopping applications normally or immediately, and manually adjusting location/point information, with proper research it is possible to develop set of interface capabilities that will provide broad coverage of typical usages in manufacturing environments.

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BIOGRAPHY

Priya Khachane: was born in Maharashtra, India, on March, 1991. She received her B. Tech degree in Electronics and Communication Engineering from UMIT College, S.N.D.T Women's University, Mumbai, India, in 2013. She is currently pursuing her M. Tech. degree in Electronics and Telecommunication Engineering from Mukesh Patel School of Technology, Management, Engineering, SVKM'S NMIMS University. Her current areas of research are wireless communication, antenna and RF.

Anuradha Nair: is currently pursuing her masters in Electronics and Telecommunication Engineering from Vivekanand Education Society's Institute of Technology, Mumbai University, India. She pursued her B. Tech from S.N.D.T University, Mumbai, India. Her M.E. project is in the area of speech processing.

Sanchali Kshirsagar: was born in India on 12th February1978. She received her B.E. in Electronics and Telecommunication from Cummins College of Engineering, Pune University in 2000. She then worked with corporate like CQSL, CyberQuest System and KPIT Cummins Ltd, Pune. She received her M.E. in Electronics and Telecommunication from S.P.I.T, Mumbai University in 2014. She is currently working as Assistant Professor in UMIT, S.N.D.T Women's University. Her current areas of research are Embedded systems, Android and Eclipse design platform and wireless sensor networks.